

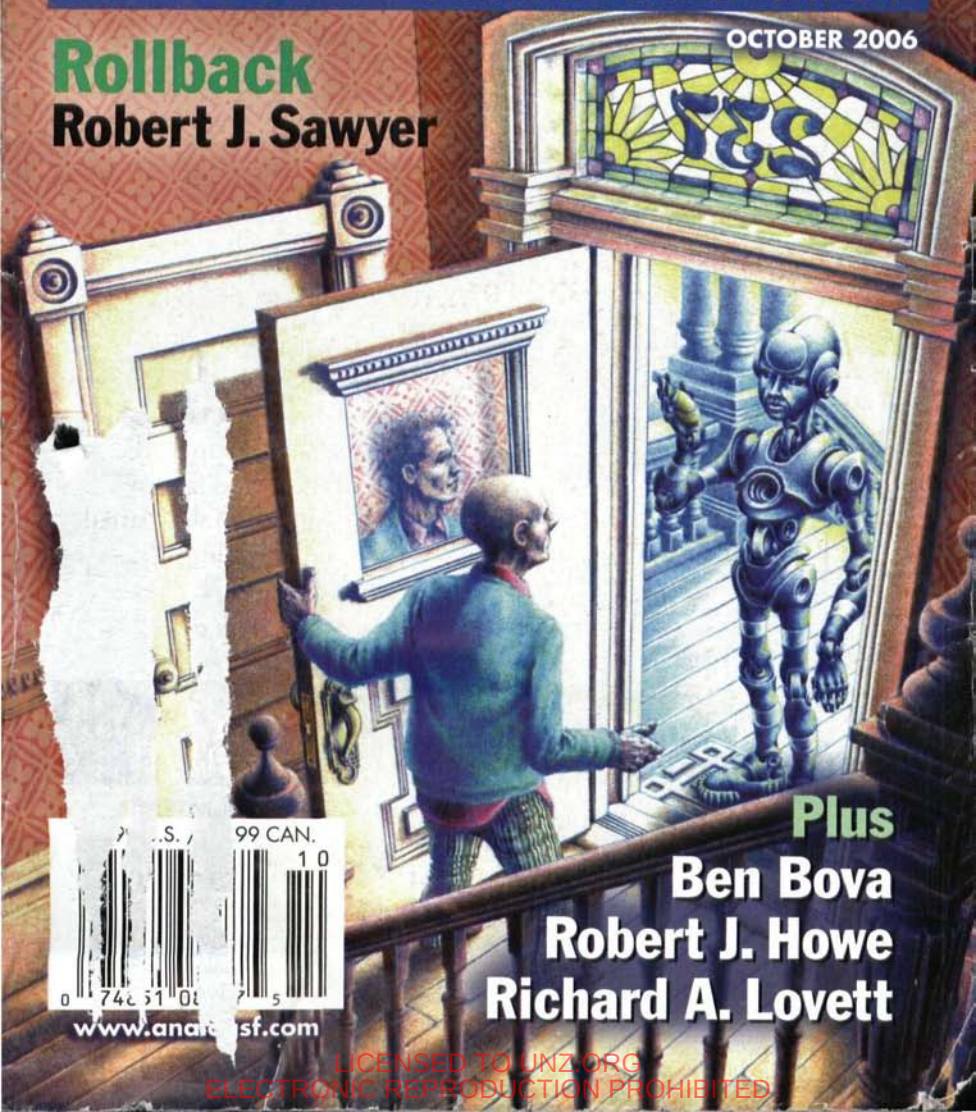
ANALOG

SCIENCE FICTION AND FACT

Rollback

Robert J. Sawyer

OCTOBER 2006



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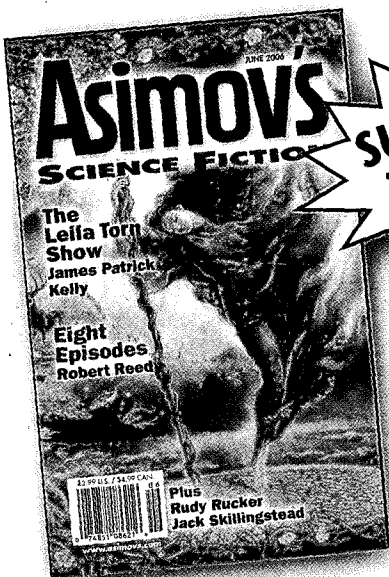
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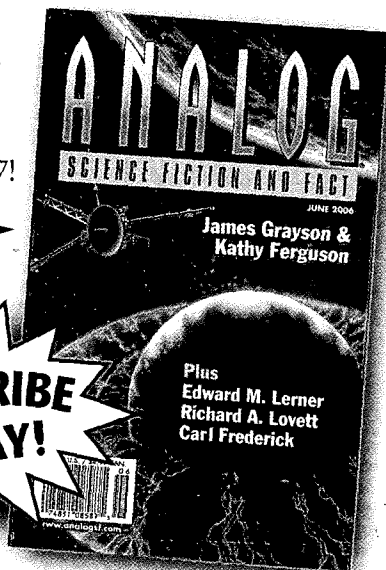
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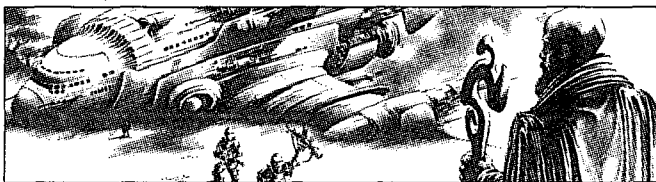
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NEEDLE WITH A NAMETAG

Anyone who has used English for more than a few years has surely encountered the phrase “like a needle in a haystack.” It refers, of course, to the difficulty of finding a specific small object in the midst of large numbers of very similar objects. For a literal needle (whether a pine needle or a sewing needle) in a literal haystack, the difficulty is obvious: finding it will involve a large amount of tedious manual picking through lots of stuff that looks alike. Even if it’s right in front of you, you may not notice it because it doesn’t stand out from its surroundings.¹

Wouldn’t it be nice, when confronted with such a task, to have a magic wand that you could simply wave at the haystack, in response to which an embedded needle would call out, “Here I am!”? While we’re dreaming, why not fix it so that if there are multiple needles in the haystack, each and every one of them will not only tell you where it is, but which one it is and what its characteristics are?

Well, for better and/or worse, we now have something that acts very much like that—not necessarily for literal needles and haystacks, but for a great many similar situations. It’s called a radio-frequency ID tag, or “RFID” for short, and its original purpose was quite practical and innocuous: to make store checkouts and inventory control easier and more accurate. Inconspicuously at-

tached to a piece of merchandise—an umbrella, a bunch of broccoli, or a boot, for example—it stores information such as the item’s exact identity and its current price. And it can spit that information out instantly in response to a “ping” (an omnidirectional coded microwave pulse), for processing by a computer associated with the reader (or scanner) that provides the ping.

Unlike the laser barcode readers we’ve all gotten used to (though our grandparents could hardly have imagined them), RFIDs don’t depend on a clerk’s holding the barcode for each item, one at a time, directly in a narrow sensing beam. Since the microwaves with which they communicate are omnidirectional, pass easily through many kinds of matter, and have considerable range, a single “ping” directed at a full shopping cart can elicit self-identification from every item in the cart. That’s enough to let the checkout computer generate a complete itemized bill. If the customer also has one of those “loyalty” cards increasingly used by stores in lieu of coupons, the RFID scanner can read that and automatically figure in several discounts offered to users of those cards—and compare this week’s purchases to previous ones to print out, along with the receipt, customized special offers likely to entice that customer back into the same store next time.

Sounds like a win-win situation for

¹ Okay, if it’s a sewing needle made of ferromagnetic metal, the job is a *little* easier, but not a lot.

everybody, right? The merchant gets a fast, accurate checkout, with few if any bookkeeping errors, and needs fewer clerks to process a given number of customers. The customer gets through the line faster, is unlikely to be overcharged, and gets several chances to save money.

And it doesn't stop there. While the merchant has an RFID scanner identifying each item sold to calculate the bill, it might as well feed that information to another program that deducts the item from inventory and keeps track of how many are left. By doing that for every item in the store, it can monitor the entire inventory on a continuous basis and let the storekeeper know whenever something needs to be reordered. It can keep track of what sells how well and therefore how much of each thing should be ordered. It can keep track of what individual customers buy a lot of, and therefore which personalized special offers are likely to be effective in bringing them back—without one person having to ask another prying questions about such things.

What “extras” does the customer get? Well, not much in the store—but things begin to get a little less clear-cut and utopian-sounding *after* the merchandise leaves the store. RFIDs are typically built right into the wares—sewn into clothing labels, for instance—so that customers are likely to be unaware of their presence, and unable to easily remove them even if they know they're there. So

they remain, and can still be read by any scanner they pass. That opens up all kinds of possibilities. A great deal of a person's history can be traced, if only in terms of where he or she was at particular times, by stored records of the presence of objects in their possession—not only at the moment of purchase, but at any time thereafter. Your credit cards and subway pass, the wallet in which you carry them, your underwear, a book you bought, the E-ZPass and tires on your car—all can serve as tattletales, giving anyone with the inclination and know-how to seek them out a wealth of data points to map much of your life and draw conclusions about it. Most of that information will never be accessed or used; there's just too much of it and most of it is of little interest to anyone. But the fact that it *can* be accessed and used should give us pause, because some of its uses can ruin lives for no good reason.

Mary Rosenblum gave a disturbing taste of the possibilities in her story “Search Engine,” which appeared here in September 2005. Edward M. Lerner, another writer well known to *Analog* readers, chillingly suggests some others in his story “The Day of the RFIDs,” which you didn't read here, but would do well to seek out anyway. It appears in his collection *Creative Destruction*, published by Wildside Press in 2006. Many of the stories in the book did appear first in *Analog*, but a couple are

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new and eminently worth reading. "The Day of the RFIDs," in particular, points out some of the possible ramifications of this modern convenience that everybody needs to think about before embracing it with unmitigated enthusiasm.

There are those, for example, who will complain that what I have said so far dwells too much on the possible negative uses of RFIDs while neglecting their power to help prevent terrorism. Some will say that the more information we have that can be used in tracking potential terrorists, both for prevention and for establishing guilt after the fact, the better off we all are. The innocent, these people will say, have nothing to fear.

How charmingly naïve.

If you are one of those who can comfortably believe that, *please* read Lerner's story, which among other things includes an all too plausible scenario for the diligent pursuit of terrorists leading instead to the deaths of numerous innocent people, massive destruction of property, and the placing of a man who never hurt anyone or anything on a "most wanted" list. It *can* happen that way, and if we're going to use the things that make it possible, we need to figure

out safeguards to make sure it doesn't.

If you're not one who can be so trusting, but think instead that you can protect yourself by such means as avoiding the use of E-ZPass, credit cards, and loyalty cards, and paying for everything with cash, think again. Some countries have already begun incorporating RFIDs into their currency, so that even "unmarked" bills leave plenty of tracks and can no longer be considered anonymous. Some countries have begun incorporating them into their passports, and others (including this one) have definite plans to do so. Many urban transit systems now *require* that fares be paid with scannable cards, and some toll road systems are moving in that direction.

All of these things have been created and adopted with good intentions, and all of them can do good and worthwhile things for us. But any tool can also be used as a weapon, and the more powerful it is in one kind of application, the more powerful it can be in the other, too. We as a people have to decide which of these aspects matters more to us, and how we can get as many as possible of the benefits of a particular technology while protecting ourselves from

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as many as possible of the dangers. These new information technologies are very powerful indeed, and we dare not assume that those who control them have only our best interests at heart, or that the guiltless have nothing to worry about. Information gathered in these ways *can* make shopping easier and help thwart genuine, malevolent terrorists. It can also be used to persecute almost anybody for almost any reason, such as a personal grudge, a political or business rivalry, or just a malicious prank. Or to establish a kind of government quite alien to the kind we have long taken care to maintain: the equipment and methods now available to would-be "Big Brothers" far exceed anything in George Orwell's writings. We can and should use these new tools, just as we use fire and electricity—but we can and must use them with no less respect and care.

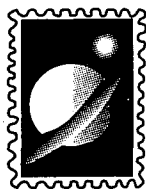
A few years ago I myself wrote a novel (*Argonaut*, Tor Books, 2002), which, at first glance and even in my own original thinking, seems to have little to do with these matters. Certainly the direct inspiration for it, at least at the conscious level, was quite different. After reading one too many manuscripts in which explor-

ers got to a new planet and in a few days learned more about it than all our scientists have learned about Earth in all of human history, I found myself thinking, "Could they really do that?" and then, "Well, maybe . . ." I thought of a way they might, in the not too distant future, using a combination of then-nascent technologies to carry out unprecedentedly widespread surveillance, data collection, and analysis. And I realized that the ability to do that would be addictively exhilarating if you were the one using it, and thoroughly terrifying if you were the one(s) being studied by entities you had no reason to trust. The result was what Michael Flynn called "the oddest alien invasion yet."

I wrote it simply because I thought it could be an enjoyable, thought-provoking story. But I now suspect that part of the reason I was drawn to the idea was its parallels to the dilemmas beginning even then to be apparent in our own burgeoning abilities to gather and use information. Large-scale, intimate spying is no less a problem whether it's done by "them" from Out There, or by some of us right here. The result, and the danger, is the same either way. ■

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Rollback

Part I of IV

Robert J. Sawyer

How do you carry on a very long,
very slow conversation?
Not the way people usually assume. . . .

*No wise man ever
wished to be younger.*

—Jonathan Swift
(1667-1745)

*How old would you be
if you didn't know how old you are?*

—Leroy "Satchel" Paige
(1906-1982)

Chapter 1

Sunday, February 2, 2048

It had been a good life.

Donald Halifax looked around the living room of the modest house that he and his wife Sarah had shared for sixty years now, and that thought kept coming back to him. Oh, there had been ups and downs, and the downs had seemed excursions into the flames of hell at the time—the lingering death of his mother, Sarah's battle with breast cancer, the rough periods their marriage had gone through—but, on

balance, when all was said and done, it had been a good life.

When all was said and done.

Don shook his head, but it wasn't in sadness. He'd always been a realist, a pragmatist, and he knew there was nothing left now but summing up and looking back. At the age of eighty-seven, that's all anyone had.

The living room was narrow. A fireplace was built into the middle of one of the long walls, flanked by autopolarizing windows, but he couldn't remember the last time they'd actually had a fire. It was too much work getting one going and then cleaning up afterward.

The mantel held framed photos, including one of Sarah and Don on their wedding day, back in 1988. She was wearing white, and he was in a tuxedo that had been black in reality but looked gray here, having faded, along with the rest of the photograph. Other photos showed their son Carl as a toddler and again graduating with his M.B.A. from

McGill, and there were two pictures of their daughter Emily, one when she was in her twenties, and another, holographic one, from her early forties. And there were several holos of their two grandchildren.

There were also a few trophies: a pair of small ones that Don had won in Scrabble tournaments, and the big one Sarah had been given by the International Astronomical Union. He couldn't remember the wording on that one, so he walked over, taking small steps, and had a look:

For Sarah Halifax
Who Figured It Out
1 March 2010

He nodded, remembering how proud he'd been that day, even if her fame had briefly turned their lives upside down.

A magphotoc flatscreen was mounted above the mantel, and when they weren't watching anything it displayed the time in boxy red numerals a foot high, big enough that Sarah could see them from across the room; as she'd often quipped, it was a good thing that she hadn't been an *optical* astronomer. It was now 3:17 in the afternoon. As Don watched, the remaining segments in the rightmost digit lit up; 3:18. The party was supposed to have begun at 3:00, but no one was here yet, and Sarah was still upstairs getting ready.

Don made a mental vow to try to not be short with the grandchildren. He never meant to snap at them, but somehow, he always did; there was a constant background level of pain at his age, and it frayed his temper.

He heard the front door opening. The house knew the kids' biometrics, and they always let themselves in without ringing the bell. The living room had a short staircase at one end that led down to the entryway and a taller one at the other going up to the bedrooms. Don walked over to the base of the one going up. "Sarah!" he called. "They're here!"

He then made his way to the other end of the room, each footfall punctuated by a tiny jab of pain. No one had come up yet—this was Toronto in February, and, global warming be damned, there were still boots and jackets to be removed. Before he reached the top of the stairs, he'd sorted out the *mêlée* of voices; it was Carl's crew.

He looked at them from his elevated vantage point and felt himself smiling. His son, his daughter-in-law, his grandson, and his granddaughter—part of his immortality. Carl was bent over in a way Don would have found excruciating, pulling off one of his boots. From this angle, Don could clearly see his son's considerable bald spot—trivial to correct, had Carl been vain, but neither Don nor his son, who was now fifty-four, could ever be accused of that.

Angela, Carl's blond wife, was ten years younger than her husband. She was working to get the boots off little Cassie, who was seated on the one chair in the entryway. Cassie, who took no active role in this, looked up and saw Don, and a huge grin spread across her little round face. "Grampa!"

He waved at her. Once all the outerwear was removed, everyone came upstairs. Angela kissed him on the cheek as she passed, carrying a rectangular cake box. She went into the kitchen. Twelve-year-old Percy was up next, then came Cassie, pulling on the banister, which she could barely reach, to help her get up the six steps.

Don bent low, feeling twinges in his back as he did so. He wanted to lift Cassie up, but that was impossible. He settled for letting her get her little arms around his neck and giving him a squeeze. Cassie was oblivious to the fact that she was hurting him, and he endured it until she let go. She then scampered through the living room and followed her mother to the kitchen. He turned to watch her and saw Sarah coming down from upstairs, one painful step at a time, gripping the bannister with

both hands as she did so.

By the time she reached the bottom step, Don heard the front door opening again, and his daughter Emily—divorced, no kids—coming in. Soon enough, everyone was crowded into the living room. With his cochlear implants, Don's hearing wasn't bad under normal circumstances, but he couldn't really pick out any one thread of conversation from the hubbub that now filled the air. Still, it was his family, all together. He was happy about that, but—

But it might be the last time. They'd gathered just six weeks ago for Christmas at Carl's place, in Ajax. His children and grandchildren wouldn't normally all get together again until next Christmas, but—

But he couldn't count on there being a next Christmas; not at his age . . .

No; that wasn't what he should be dwelling on. Today was a party, a celebration. He should enjoy it, and—

And suddenly there was a champagne flute in his hand. Emily was circling the room, handing them out to the adults, while Carl presented plastic tumblers of juice to the children.

"Dad, go stand by Mom," Carl said. And he did so, making his way across the room to where she was—not standing; she couldn't stand for long. Rather, she was seated in the old La-Z-Boy. Neither of them ever reclined it anymore, although the grandkids loved to operate the mechanism. He stood next to Sarah, looking down on her thinning snow-white hair. She craned her neck as much as she could to look up at him, and a smile crossed her face, one more line in a landscape of creases and folds.

"Everybody, everybody!" shouted Carl. He was the elder of Don and Sarah's kids and always took charge. "Your attention, please!" The conversation and laughter died down quickly, and Don watched as Carl raised his own champagne flute. "I'd like to propose a toast. To Mom and Dad, on their sixtieth wedding anniversary!"

The adults all raised their glasses, and, after a moment, the kids imitated them with their tumblers. "To Don and Sarah!" said Emily, and, "To Grandma and Grandpa," declared Percy.

Don took a sip of the champagne, the first alcohol he'd had since New Year's Eve. He noted his hand was shaking even more than it normally did, not from age but with emotion.

"So, Dad, what do you say?" asked Carl. He was grinning from ear to ear. Emily, for her part, was recording everything with her datacom. "Would you do it all over again?"

Carl had asked the question, but Don's answer was really for Sarah. He set his glass on a little tea table next to the La-Z-Boy, then slowly, painfully, lowered himself onto one knee, so that he was at eye level with his seated wife. He reached over, took her hand, feeling the thin, almost translucent skin sliding over the swollen joints, and looked into her pale blue eyes. "In a heartbeat," he said softly.

Emily let out a long, theatrical, "Awww . . ."

Sarah squeezed his hand, and she smiled at him, the same wry smile he'd fallen for back when they were both in their twenties, and she said, with a steadiness that her voice almost never managed these days, "Me, too."

Carl's exuberance got the better of him. "To another sixty years!" he said, lifting his glass again, and Don found himself laughing at the ridiculousness of the proposition.

"Why not?" he said, slowly rising again, then reaching for his glass. "Why the heck not?"

The phone rang. He knew his kids thought the voice-only phones were quaint, but neither he nor Sarah had any desire to have 2D picture phones, let alone holophones. His first thought was not to answer; let whoever it was leave a message. But it was probably a well-wisher—maybe even his brother Bill calling from Florida, where he wintered.

The cordless handset was on the other side of the room. Don lifted his eyebrows and nodded at Percy, who looked delighted to be charged with such a task. He raced across the room, and rather than just bringing over the handset, he activated it and very politely said, "Halifax residence."

It was possible that Emily, standing near Percy, could hear the person on the other end of the line, but Don couldn't make out anything. After a moment, he heard Percy say, "Just a sec," and the boy started walking across the room. Don held out his hand to take the handset, but Percy shook his head. "It's for Grandma."

Sarah looked surprised as she took the handset, which, upon recognizing her fingerprints, automatically cranked up its volume. "Hello?" she said.

Don looked on with interest, but Carl was talking to Emily while Angela was making sure her children were being careful with their drinks, and—

"Oh, my God!" exclaimed Sarah.

"What is it?" asked Don.

"Are you sure?" Sarah said, into the mouthpiece. "Are you positive it's not—No, no, of course you'd check. Sorry. But—my God!"

"Sarah," said Don, "what is it?"

"Hang on, Lenore," Sarah said into the phone, then she covered the mouthpiece with a trembling hand. "It's Lenore Darby," she said, looking up at him. He gathered he should know the name, but couldn't place it immediately—the story of his life, these days—and his face must have conveyed that. "You know," said Sarah. "She's doing her master's; you met her at the last astro-department Christmas party."

"Yes?"

"Well," said Sarah, sounding as though she couldn't believe that she was uttering these words, "Lenore says a reply has been received."

"What?" said Carl, now standing on the other side of her chair.

Sarah turned to face her son, but Don

knew what she meant before she spoke again; he knew precisely what she meant, and he staggered a half-pace backward, groping for the edge of a bookcase for support. "A reply has been received," repeated Sarah. "The aliens from Sigma Draconis have responded to the radio message my team sent all those years ago."

Chapter 2

Most jokes get tired with repetition, but some become old friends, causing a smile whenever they come to mind. For Don Halifax, one such was a quip Conan O'Brien had made decades ago. Michael Douglas and Catherine Zeta-Jones had just announced the birth of their baby girl. "Congratulations," O'Brien had said. "And if she's anything like her mother, right now her future husband is in his mid-forties."

There was no such age gap between Don and Sarah. They'd both been born in 1960 and had gone through life in lockstep. They'd both been twenty-seven when they'd gotten married; thirty-two when Carl, their first child, had been born; and forty-eight when—

As Don stood, looking at Sarah, the moment came back to him, and he shook his head in amazement. It had been front-page news, back when there *were* front pages, all over the world. On March first, 2009, a radio message had been received from a planet orbiting the star Sigma Draconis.

The world had puzzled over the message for months, trying to make sense of what the aliens had said. And then, finally, Sarah Halifax herself had figured out what they were getting at, and it was she who had led the team composing the official reply that had been sent on the one-year anniversary of the receipt of the original signal.

The public had initially been hungry for more news, but Sigma Draconis was 18.8 light-years from Earth, meaning the reply wouldn't reach there until 2028, and any response the Dracons might

make couldn't have gotten here until October 2047 at the earliest.

And a few TV shows and webcasts had dutifully done little pieces last fall noting that a response could be received "any day now." But none was. Not in October, not in November, not in December, not in January, not . . .

Not until right now.

No sooner had Sarah gotten off the phone with Lenore than it rang again. The call, as she revealed in a stage whisper while holding her hand over the mouthpiece, was from CNN. Don remembered the pandemonium the last time, when she had figured out the purpose of the first message—God, where had the decades gone?

Everyone was now standing or sitting in a semicircle, looking at Sarah. Even the children had recognized that something major was going on, although they had no idea what.

"No," Sarah was saying. "No, I have no comment. No, you can't. It's my anniversary today. I'm not going to let it be ruined by strangers in the house. What? No, no. Look, I really have to go. All right, then. All right, then. Yes, yes. Good-bye." She pushed the button that terminated the call, then looked up at Don, and lifted her frail shoulders a bit. "Sorry for all the bother," she said. "It's—"

The phone rang again, an electronic bleeping that Don disliked at the best of times. Carl, taking command, took the handset from his mother and flicked off the ringer. "They can leave a message if they like."

Sarah frowned. "But what if somebody needs help?"

Carl spread his arms. "Your whole family is here. Who else would call for help? Relax, Mom. Let's enjoy the rest of the party."

Don looked around the room. Carl had been sixteen when his mother had been briefly famous, but Emily had been just ten, and hadn't really understood what had been going on. She was star-

ing at Sarah with astonishment on her narrow face.

Phones in the other rooms were ringing, but they were easy enough to ignore. "So," he said, "did—what was her name? Lenore? Did she say anything about the message's content?"

Sarah shook her head. "No. Just that it was definitely from Sigma Draconis, and seems to begin, at least, with the same symbol set used last time."

Angela said, "Aren't you dying to know what the reply says?"

Sarah reached out her arms in a way that said "help me up." Carl stepped forward and did just that, gently bringing his mother to her feet. "Sure, I'd like to know," she said. "But it's still coming in." She looked at her daughter-in-law. "So let's get started making dinner."

The kids and grandkids left around 9:00 P.M. Carl, Angela, and Emily had done all the work cleaning up after dinner, and so Don and Sarah simply sat on the living-room couch, enjoying the restored calm. Emily had gone around at one point, shutting off all the other ringers on the phones, and they were still off. But the answering machine's digital display kept changing every few minutes. Don was reminded of another old joke, this one from his teenage years, about the guy who liked to follow Elizabeth Taylor to McDonald's so he could watch the numbers change. Those signs had been stuck at "Over 99 Billion Served" for decades, but he remembered the hoopla when they'd all finally been replaced with new ones that read, "Over 1 Trillion Served."

Sometimes it was better to just stop counting, he thought—especially when it's a counting down instead of a counting up. They'd both made it to eighty-seven, and to sixty years together. But they surely wouldn't be around for a seventieth anniversary; that just wasn't in the cards. In fact . . .

In fact, he was surprised they'd lived this long, but maybe they'd been hold-

ing on, striving to reach the diamond milestone. All his life, he'd read about people who died just days after their eightieth, ninetieth, or hundredth birthdays. They'd clung to life, literally by the force of their wills, until the big day had been reached, and then they'd just let go.

Don had turned eighty-seven three months ago, and Sarah had done so five months before that. That hadn't been what they'd been holding on for. But a sixtieth wedding anniversary! How rare that was!

He would have liked to put his arm around Sarah's shoulders as they sat side by side on the couch, but it pained him to rotate his own shoulder that much, and—

And then it hit him. Maybe she hadn't been hanging on for their anniversary. Maybe what had really kept her going all this time was waiting to see what reply the Dracons would send. He wished contact had been made with a star thirty or forty light-years away, instead of just nineteen. He wanted her to keep holding on. He didn't know what he'd do if she let go, and—

And he'd read *that* news story, too, dozens of times over the years: the husband who dies only days after his wife; the wife who finally seems to give up and let go shortly after hubby passes away.

Don knew a day like today called for some comment, but when he opened his mouth, what came out were just two words, that, he guessed, summarized it all: "Sixty years."

She nodded. "A long time."

He was quiet for a while, then: "Thank you."

She turned her head to look at him. "For what?"

"For—" He lifted his eyebrows and raised his shoulders a bit as he sought an answer. And then, finally, he said, very softly, "Everything."

Next to them, on the little table beside the couch, the counter on the an-

swering machine tallied up another call. "I wonder what the aliens' reply says," Don said. "I hope it's not just one of those damn autoresponders. 'I'm sorry, but I'll be away from the planet for the next million years.'" Sarah laughed, and Don went on. "If you need immediate assistance, please contact my assistant Zagdorf at . . ."

"You are a supremely silly man," she said, patting the back of his hand.

Even though they only had voice phones, Sarah and Don did have a modern answering machine. "Forty-eight calls were received since you last reviewed your messages," the device's smooth male voice said the next morning as they sat at the dining-room table. "Of those, thirty-nine left messages. All thirty-nine were for Sarah. Thirty-one were from the media. Rather than presenting them in order of receipt, I suggest you let me prioritize them for you, sorting by audience size. Starting with the TV networks, CNN—"

"What about the calls that weren't from the media?" Sarah asked.

"The first was from your hair dresser. The second is from the SETI Institute. The third is from the Department of Astronomy and Astrophysics at the University of Toronto. The fourth—"

"Play the one from U of T."

A squeaky female voice came on. "Good morning, Professor Halifax. This is Lenore again—you know, Lenore Darby. Sorry to be phoning so early, but I thought someone should give you a call. Everyone's been working on interpreting the message as it comes in—here, over in Mountain View, at the Allen, everywhere—and, well, you're not going to believe this, Professor Halifax, but we think the message is"—the voice lowered a bit, as if its owner was embarrassed to go on—"encrypted. Not just encoded for transmission, but actually encrypted—you know, scrambled so that it can't be read without a decryption key."

Sarah looked at Don, her face astonished. Lenore went on. "I know sending us an encrypted message doesn't make any sense, but that seems to be what the Dracons have done. The beginning of the message is all math stuff, laid out in that symbol set they used before, and the computer gunks say the math describes a decryption algorithm. And then the rest of the message is total gibberish, presumably because it has indeed been encrypted. Get it? They've told us *how* the message is encrypted, and given us the algorithm to unlock it, but they haven't given us the decryption key to feed into that algorithm to do the actual unlocking. It's the craziest thing, and—"

"Pause," said Sarah. "How long does she go on?"

"Another two minutes, sixteen seconds," said the machine, and then it added, "She's quite chatty."

Sarah shook her head and looked at Don. "Encrypted!" she declared. "That doesn't make any sense. Why in God's name would aliens send us a message we can't read?"

Chapter 3

Sarah fondly remembered *Seinfeld*, although, sadly, it hadn't aged well. Still, one of Jerry's bits of standup seemed as true today as it had been half-a-century ago. When it came to TV, most men were hunters, switching from channel to channel, always on the prowl for something better, while women were nesters, content to settle in with a single program. But today, Sarah found herself scanning constantly; the puzzle of the encrypted message from Sigma Draconis was all over the TV and the web. She caught coverage of odds-makers paying off winners who'd correctly guessed the day on which a reply would be received, fundamentalists decrying the new signal as a temptation from Satan, and crackpots claiming to have already decrypted the secret transmission.

Of course, she was delighted that

there had been a reply, but as she continued to flip channels on the giant monitor above the mantel, she reflected that she was also disappointed that in all the years since they'd detected the first message, no other alien radio source had been found. As Sarah had once said in an interview very much like the ones she was looking at today, it was certainly true that we weren't alone—but we were still pretty lonely.

Her surfing was interrupted each time someone came up to the front door and rang the bell; an image of whoever it was automatically appeared on the monitor. Mostly it seemed to be reporters; there were still a few journalists who did more than send email, make phone calls, and surf the web.

Those neighbors who had lived here on Betty Ann Drive four decades ago knew Sarah's claim to fame, but most of the houses had changed hands several times since then. She wondered what her newer neighbors made of the succession of news vans that had pulled into her driveway. Ah, well; at least it wasn't something to be embarrassed about, like the cop cars that kept showing up at the Kuchma place across the road and, so far, Sarah had simply ignored all the people who had rung her doorbell, but—

My God.

But she couldn't ignore *this*.

The face that had suddenly appeared on the monitor was not human.

"Don!" she called, her voice dry. "Don, come here!"

He had gone into the kitchen to make coffee—decaf, of course; it was all Dr. Bonhoff would let either of them have these days. He shuffled into the living room, wearing a teal cardigan over an untucked red shirt. "What?"

She gestured at the monitor. "My . . . goodness," he said softly. "How'd it get here?"

She pointed at the screen. Partially visible behind the strange head was their driveway, which Carl had shoveled be-

fore leaving yesterday. An expensive-looking green car was sitting on it. "In that, I guess."

The doorbell rang once more. She doubted the being pushing the button was actually getting impatient. Rather, she suspected, some dispassionate timer told it to try again.

"Do you want me to let it in?" asked Don, still looking at the picture of the round, blue face, with its unblinking eyes.

"Um, sure," Sarah said. "I guess."

She watched as he made his way to the little staircase leading to the entryway, and began the slow pilgrimage down, one painful step at a time. She followed him and stood at the top of the stairs—and noted that one of her grandkids had forgotten a colorful scarf here. By the time Don reached the door, the bell had sounded a third time, which was the maximum number it was programmed to allow. He undid the dead-bolt and the chain, and swung the heavy oak door inward, revealing—

It had been weeks since Sarah had seen one in the flesh—not that "in the flesh" was the right phrase.

Standing before them, gleaming in the sunlight, was a robot, one of the very latest models, she guessed; it looked more sophisticated and sleeker than any she'd seen before.

"Hello," the robot said to Don, in a perfectly normal male voice. It was about five-foot-six: tall enough to function well in the world, but not so tall as to be intimidating. "Is Dr. Sarah Halifax in?"

"I'm Sarah Halifax," she said. The robot's head swiveled to look up at her. Sarah suspected it was analyzing both her face and her voice to make sure it was really her.

"Hello, Dr. Halifax," the robot said. "You haven't been answering your household phone, so I've brought you a replacement. Someone would like to talk to you." The robot raised its right hand, and in it Sarah could just make out

a clamshell datacom.

"And who might that be?" she asked.

The robot tilted its head slightly, giving the impression that it was listening to someone somewhere else. "Cody McGavin," it said. Sarah felt her heart skip a beat; she wished she'd actually been on the staircase, instead of just above it, so she could have grabbed the bannister for support. "Will you take his call?"

Don turned to look at Sarah, his eyes wide, jaw hanging slack.

"Yes," she said.

The word had come out very softly, but the robot apparently had no trouble hearing her. "May I?" it asked.

Don nodded and stepped aside. The robot came into the entryway, and, to Sarah's astonishment, she saw it was wearing simple, stylized galoshes, which, in a fluid motion, it bent over and removed, exposing blue metal feet. The machine walked across the vestibule, its heels clicking against the old, much-scuffed hardwood there, and it easily went up the first two steps, which was as far as it had to go to be able to proffer the datacom to Sarah. She took it.

"Flip it open," the robot said helpfully.

She did so, then heard a ringing through the small speaker. She quickly brought the device to her ear.

"Hello, Dr. Halifax," said a crisp female voice. It was a little hard for Sarah to make out; she wished she knew how to adjust the volume. "Please hold for Mr. McGavin."

Sarah looked at her husband. She'd repeatedly told him how much she hated people who made her wait like this. It was almost always some self-important jackass who felt his time was more valuable than anyone else's. But in this case, Sarah supposed, that was actually true. Oh, there might be a few people on Earth who made more per hour than Cody McGavin, but, offhand, she couldn't name any of them.

As Sarah often said, SETI is the

Blanche Dubois of scientific undertakings: it has always depended on the kindness of strangers. Whether it was Microsoft co-founder Paul Allen donating 13.5 million dollars in 2004 to fund an array of radio telescopes, or the hundreds of thousands of private computer users who gave up their spare processing cycles to the SETI@home project, the Search for Extraterrestrial Intelligence had managed to struggle on decade after decade through the largesse of those who believed, first, that we might not be alone, and, later, that it actually mattered that we were not alone.

Cody McGavin had made billions by the time he was forty, developing robotic technology. His proprioceptive sensor webs were behind every sophisticated robot on the planet. Born in 1985, he'd been fascinated by astronomy, science fiction, and space travel all his life. His collection of artifacts from the *Apollo* program, an endeavor that had come and gone long before he was born, was the largest in the world. And, after the passing of Paul Allen, he'd become by far SETI's biggest single benefactor.

As soon as Sarah had been put on hold, music started playing. She recognized it as Bach—and got the joke; she was probably one of the few people left alive who would. Years ago, long before the first Draconis signal had been received, during a discussion of what message should be beamed to the stars, Carl Sagan had vetoed the suggestion of Bach, because, he'd said, "That would be bragging."

In the middle of the concerto, the famous voice came on; McGavin spoke with one of those Boston accents that managed to say "Harvard" with no discernible *R* sound. "Hello, Dr. Halifax. Sorry to keep you waiting."

She found her voice cracking in a way that had nothing to do with age. "That's all right."

"Well, they did it, didn't they?" he said, with relish. "They replied."

"It seems so, sir." There weren't many people an eighty-seven-year-old felt inclined to call "sir," but it had come spontaneously to her lips.

"I knew they would," said McGavin. "I just knew it. We've got us a dialogue going here."

She smiled. "And now it's our turn to reply again—once we figure out how to decrypt the message." Don had been moving across the little entryway, and now was climbing the six stairs. When he was all the way up, she held the datacom at an angle to her face so he could hear McGavin, too. The robot, meanwhile, had taken up a position just inside the front door.

"Exactly, exactly," said McGavin. "We've got to keep the conversation going. And that's what I'm calling about, Sarah—you don't mind if I call you Sarah, do you?"

She actually quite liked it when younger people called her by her first name; it made her feel more alive. "Not at all."

"Sarah, I've got a—call it a proposition for you."

Sarah couldn't help herself. "My husband is standing right here."

McGavin chuckled. "A proposal, then."

"Still here," said Don.

"Hee hee," said McGavin. "Let's call it an offer, then. An offer I don't think you'll want to refuse."

Don used to do a good Brando in his youth. He puffed out his cheeks, frowned, and moved his head as if shaking jowls, but said nothing. Sarah laughed silently and swatted his arm affectionately. "Yes?" she said, into the datacom.

"I'd like to discuss it with you face to face. You're in Toronto, right?"

"Yes."

"Would you mind coming down here, to Cambridge? I'd have one of my planes bring you down."

"I . . . I wouldn't want to travel without my husband."

"Of course not; of course not. This affects him, too, in a way. Won't you both come down?"

"Um, ah, give us a moment to discuss it."

"Of course," said McGavin.

She covered the mike and looked at Don with raised eyebrows.

"Back in high school," he said, "we had to make a list of twenty things we wanted to do before we die. I came across mine a while ago. One of the ones I haven't checked off yet is, 'Take a ride in a private jet.'"

"All right," she said, into the datacom. "Sure. Why not?"

"Terrific, terrific," said McGavin. "We'll have a limo pick you up and take you to Trudeau in the morning, if that's okay."

Trudeau was in Montreal; the Toronto airport was Pearson—but Sarah knew what he meant. "Fine, yes."

"Wonderful. I'll have my assistant come on, and he'll look after all the details. We'll see you in time for lunch tomorrow."

And the Bach started up again.

Chapter 4

It was ironic, now that Don thought back on it, how often he and Sarah had talked about SETI's failure prior to its success. He'd come home one day, around—let's see; they'd been in their mid-forties, so it must have been something like 2005—to find her sitting in their just-bought La-Z-Boy, listening to her iPod. Don could tell she wasn't playing music; she couldn't resist tapping her fingers or toes whenever she was doing that.

"What are you listening to?" he asked.

"It's a lecture," shouted Sarah.

"Oh, really!" he shouted back, grinning.

She took out the little white earbuds, looking sheepish. "Sorry," she said, in a normal volume. "It's a lecture Jill did for The Long Now Foundation."

SETI, Don often thought, was like

Hollywood, with its stars. In Tinsel Town, having to use last names marked you as an outsider, and the same was true in Sarah's circles, where Frank was always Frank Drake, Paul was Paul Shuch, Seth was Seth Shostak, Sarah was indeed Sarah Halifax, and Jill was Jill Tarter.

"The long what?" Don said.

"The Long Now," repeated Sarah. "They're a group that tries to encourage long-term thinking, thinking about *now* as an epoch rather than a point in time. They're building a giant clock—the Clock of the Long Now—that ticks once a year, chimes once a century, and has a cuckoo that comes out every millennium."

"Good work if you can get it," he said. "Say, where are the kids?" Carl had been twelve then; Emily, six.

"Carl's downstairs watching TV. And I sent Emily to her room for drawing on the wall again."

He nodded. "So what's Jill talking about?" He'd never met Jill, although Sarah had.

"Why SETI is, by necessity, a long-term proposition," Sarah said. "Except she's skirting the issue."

"You and she are practically the only SETI researchers who can do that."

"What? Oh."

"I'm here all week."

"Lucky me. Anyway, she doesn't seem to be getting to the point, which is that SETI is something that *must* be a multi-generational activity, like building a great cathedral. It's a trust, something we hand down to our children, and they hand down to their children."

"We don't have a good track record with things like that," he said, perching now on the La-Z-Boy's broad, padded arm. "I mean, you know, the environment is something we hold in trust and pass on to Carl and Emily's generation, too. And look at how little our generation has done to combat global warming."

She sighed. "I know. But Kyoto's a

ANALOG

step forward."

"It'll hardly make a dent."

"Yeah, well."

"But, you know," said Don, "we're not cut out for this—what did you call it?—this 'Long Now' sort of thinking. It's anti-Darwinian. We're hardwired against it."

She sounded surprised. "What?"

"We did something about kin selection on *Quirks and Quarks* last month; I spent forever editing the interview." Don was an audio engineer at CBC Radio. "We had Richard Dawkins on again, by satellite through the Beeb. He said that in a competitive situation, you automatically favor your own son over your brother's son, right? Of course: your son has half your DNA, and your brother's son only has a quarter of it. But if things got tough between your brother's son and your cousin, well, you'd favor your brother's son—that is, your nephew—because your cousin only has an eighth of your DNA."

"That's right," Sarah said. She was scratching his back. It felt very nice.

He went on. "And a second cousin only has one thirty-second of your DNA. And a second cousin once removed has just one sixty-fourth of your DNA. Well, when was the last time you heard of somebody volunteering a kidney to save a second cousin once removed? Not only do most people have no clue who their second cousins once removed are, but they also, quite bluntly, couldn't give a crap what happens to them. They just don't share enough DNA with them to care."

"I love it when you talk math," she teased. Fractions were about as good as Don's math got.

"And over time," he said, "the DNA share gets cut down, like cheap coke." He grinned, delighted by his simile, although she knew full well that the only coke he had experience with came in silver-and-red cans. "You only have to go six generations to get to your own descendants being as distantly related to

you as a second cousin once removed—and six generations is less than two centuries."

"I can name my second cousins once removed. There's Helena, and Dillon, and—"

"But you're special. That's why you *are* interested in SETI. For the rest of the world, they just don't have a vested Darwinian interest. Evolution has shaped us so that we don't care about anything that's not going to manifest soon, because no close relative of ours will be around then. Jill's probably tap-dancing around that, because it's a point she *doesn't* want to make: that, for the general public, SETI doesn't make sense. Hell, didn't Frank"—whom he'd also never met—"send a signal somewhere thousands of light-years away?"

He looked at Sarah, and saw her nod. "The Arecibo message, sent in 1974. It was aimed at M13, a globular cluster."

"And how far away is M13?"

"Twenty-five thousand light-years," she said.

"So it'll be fifty thousand years before we could get a reply. Who has the patience for something like that? Hell, I got an email today with a PDF attachment, and I thought, geez, I wonder if this thing is going to be worth reading, 'cause, you know, it's going to take, like, *ten whole seconds* for the attachment to download and open. We want instant gratification; we find *any* delay intolerable. How can SETI fit into a world with that mindset? Send a message and wait decades or centuries for a reply?" He shook his head. "Who the hell would want to play that game? Who's got the time for it?"

Chapter 5

As the luxury jet landed, Don Halifax mentally checked off that to-do list item. The few remaining ones, including "sleep with a supermodel" and "meet the Dalai Lama," seemed out of the question at this point, not to mention of no current interest.

ROBERT J. SAWYER

It was bitterly cold going down the little metal staircase onto the tarmac. The flight attendant helped Don every step of the way, while the pilot helped Sarah. Downside of a private plane: it didn't use a Jetway. Like so many of the things on Don's list, this one was turning out to be less wonderful than he'd hoped.

A white limo was waiting for them. The robot driver wore one of those caps that limo drivers are supposed to wear, but nothing else. It did an expert job of getting them to McGavin Robotics, all the while providing a running commentary, in a voice loud enough for them to hear clearly, on the sights and history of the area.

The McGavin Robotics corporate campus consisted of seven sprawling buildings separated by wide snow-covered expanses; the company had lots of ties to the artificial-intelligence lab at nearby MIT. The limo was able to go straight into an underground garage, so Don and Sarah didn't have to brave the cold again. The robot driver escorted them as they walked slowly over to an immaculate elevator, which brought them up to the lobby. Human beings took over there, taking their coats, making them welcome, and bringing them up another elevator to the fourth floor of the main building.

Cody McGavin's office was long and narrow, covering one whole side of the building, with windows looking out over the rest of the campus. His desk was made of polished granite, and a matching conference table with a fleet of fancy chairs docked at it was off to the left, while a long, well-stocked bar, with a robot bartender, stretched off in the other direction.

"Sarah Halifax!" said McGavin, rising from his high-backed leather chair.

"Hello, sir," said Sarah.

McGavin quickly closed the distance between them. "This is an honor," he said. "A real honor." He was wearing what Don supposed was the current fashion for executives: a lapel-less dark-

green sports jacket and a lighter green shirt with a vertical splash of color down the front taking the place of a tie. No one wore ties anymore.

"And this must be your husband," said McGavin.

"Don Halifax," said Don. He offered his hand—something he disliked doing these days. Too many younger people squeezed too hard, causing him real pain. But McGavin's grip was gentle, and released after only a moment.

"A pleasure to meet you, Don. Please, won't you have a seat?" He gestured back toward his desk and, to Don's astonishment, two luxurious leather-upholstered chairs were rising up through hatches in the carpeted floor. McGavin helped Sarah across the room, offering her his arm, and got her seated. Don shuffled across the carpet and lowered himself into the remaining chair, which seemed solidly anchored now.

"Coffee?" said McGavin. "A drink?"

"Just water," said Sarah. "Please."

"The same," said Don.

The rich man nodded at the robot behind the bar, and the machine set about filling glasses. McGavin perched his bottom on the edge of the granite desk and faced Don and Sarah. He was not a particularly good-looking man, thought Don. He had doughy features and a small, receding chin that made his already large forehead seem even bigger. Still, he'd doubtless had some cosmetic work done. Don knew he was sixty-something, but he didn't look a day over twenty-five.

The robot was suddenly there, handing Don a beautiful crystal tumbler full of water, with two ice cubes bobbing in it. The machine handed a similar glass to Sarah, and one to McGavin, and then silently withdrew to behind the bar.

"Now," said McGavin, "let's talk turkey. I said I've got a"—he paused, and gave the word a special weight, recalling the banter of the day before—"proposition for you." He was looking at Sarah exclusively, Don noted. "And I do."

Sarah smiled. "As we used to say about the Very Large Array, I'm all ears."

McGavin nodded. "The first message we got from Sig Drac was a real poser, until *you* figured out its purpose. And this one is even more of a puzzle, it seems. Encrypted! Who'd have guessed?"

"It's baffling," she agreed.

"That it is," said McGavin. "That it is. But I'm sure you can help us crack it."

"I'm no expert in decryption or codes, or things like that," she said. "My expertise, if I have any, is in exactly the opposite: understanding things that were designed to be read by anyone."

"Granted, granted. But you had such insight into what the Dracons were getting at last time. And we know *how* to decrypt the current message. I'm told the aliens made the technique very clear. All we have to do is figure out *what* the decryption key is, and I suspect your skill is going to be valuable there."

"You're very kind," she said, "but—"

"No, really," said McGavin. "You were a crucial part of it then, I'm sure you're going to be a crucial part of it now, and you'll continue to be so well into the future."

She blinked. "The future?"

"Yes, yes, the future. We've got a dialogue going here, and we need *continuity*. I'm sure we'll unlock the current message, and, even if we don't, we'll still send a response. And I want you to be around when the reply to that response arrives."

Don felt his eyes narrowing, but Sarah just laughed. "Don't be silly. I'll be dead long before then."

"Not necessarily," said McGavin.

"It'll be thirty-eight years, minimum, before we get a reply to anything we send today," she said.

"That's right," replied McGavin, his tone even.

"And I'd be—well, um . . ."

"A hundred and twenty-five," McGavin supplied.

Don had had enough. "Mr. McGavin,

don't be cruel. My wife and I have only a few years left, at best. We both know that."

Sarah had drained her water glass. The robot silently appeared with a replacement and swapped it for the empty one.

McGavin looked at Don. "The press has had it all wrong, you know, from day one. Most of the SETI community hasn't understood, either. This isn't a case of Earth talking to the second planet of the star Sigma Draconis. Planets don't talk to each other. *People* do. Some specific person on Sigma Draconis II sent the message, and one specific person on this planet—you, Dr. Sarah Halifax—figured out what he'd asked for, and organized our reply. The rest of us—all the humans here, and anyone else on Sigma Draconis who is curious about what's being said—have been reading over your shoulders. You've got a pen pal, Dr. Halifax. It happens that I, not you, pay the postage, but he's *your* pen pal."

Sarah looked at Don, then back at McGavin. She took another sip of her water, perhaps to buy herself a few seconds to think. "That's an . . . *unusual* interpretation," she said. "Because of the long times between sending messages and receiving replies, SETI is something whole civilizations do, not individuals."

"No, no, that's not right at all," said McGavin. "Look, what are the fundamental tenets of SETI? Certainly one of them is this: almost any race we contact will be more advanced than us. Why? Because, as of this year, we've only had radio for a hundred and fifty-three years, which is nothing compared to the eleven billion years the universe is old. It's a virtual certainty that anyone we make contact with has been around as a radio-using civilization longer than we have."

"Yes," said Sarah, and "So?" added Don.

"So," said McGavin, "short life spans are something only technologically un-

sophisticated races will be subject to. How long after a race develops radio do you think it is before they decode DNA, or whatever their genetic material is? How long before they develop blood transfusions and organ transplantation and tissue cloning? How long before they cure cancer and heart disease, or whatever comparable ailments sloppy evolution has left them prey to? A hundred years? Two hundred? Doubtless no more than three or four, right? Right?"

He looked at Sarah, presumably expecting her to nod. She didn't, and, after a moment, he went on anyway. "Just as every race we contact almost certainly must have had radio longer than we have, every race we contact will almost certainly have extended their life spans way beyond whatever paltry handful of years nature originally dealt them." He spread his arms. "No, it stands to reason: communication between two planets isn't something one generation starts, another continues, and still another picks up after that. Even with the long timeframes imposed by the speed of light, interstellar communication is still almost certainly communication between individuals. And you, Dr. Halifax, are *our* individual. You already proved, all those years ago, that you know how they think. Nobody else managed that."

Her voice was soft. "I—I'm happy to be the, um, the public face for our reply to the current message, if you think that's necessary, but after that . . ." She lifted her narrow shoulders slightly as if to say the rest was obvious.

"No," said McGavin. "We need to keep you around for a good long time."

Sarah was nervous; Don could tell, even if McGavin couldn't. She lifted her glass and swirled the contents so that the ice cubes clinked together. "What are you going to do? Have me stuffed and put on display?"

"Goodness, no."

"Then what?" Don demanded.

"Rejuvenation," said McGavin.

"Pardon me?" said Sarah.

"Rejuvenation; a rollback. We'll make you young again. Surely you've heard about the process."

Don had indeed heard about it, and doubtless Sarah had, too. But only a couple of hundred people had undergone the procedure so far, and they'd all been stinking rich.

Sarah reached forward and set her glass down on the granite desktop, next to where McGavin was leaning. Her hand was shaking. "That . . . that costs a fortune," she said.

"I have a fortune," said McGavin simply.

"But . . . but . . . I don't know," said Sarah. "I'm—I mean, does it work?"

"Look at me," said McGavin, spreading his arms again. "I'm sixty-two years old, according to my birth certificate. But my cells, my telomeres, my free-radical levels, and every other indicator, say I'm twenty-five. And, if anything, I feel younger even than that."

Don's jaw must have been hanging open in surprise. "You thought I'd had a facelift, or something like that?" McGavin said, looking at him. "Plastic surgery is like a software patch. It's a quick, kludgy fix, and it often creates more problems than it solves. But rejuvenation, well, that's like a code rewrite—it's a *real* fix. You don't just look young again; you *are* young." His thin eyebrows climbed his wide forehead. "And that's what I'm offering you. The full-blown rejuvenation treatment."

Sarah looked shocked, and it was a moment before she spoke. "But . . . but this is ridiculous," she said at last. "Nobody even knows if it really works. I mean, sure, you *look* younger, maybe you even *feel* younger, but the treatment has only been available for a short time. No one who's had it yet has lived appreciably longer than a natural lifespan. There's no proof that this process really extends your life."

McGavin made a dismissive gesture. "There have been lots of rollback tests with lab animals. They all became young

again, and then aged forward perfectly normally. We've seen mice and even prosimians live out their entire lengthened lifespans without difficulty. As for humans, well, except for a few odd-ball indicators like growth rings in my teeth, my physicians tell me that I'm now physiologically twenty-five, and am aging forward naturally from that point." He spread his arms. "Believe me, it works. And I'm offering it to you."

"Mr. McGavin," Don said, "I really don't think that—"

"Not without Don," Sarah said.

"What?" said McGavin and Don simultaneously.

"Not without Don," Sarah repeated. Her voice had a firmness Don hadn't heard for years. "I won't even consider this unless you also offer the same thing to my husband."

McGavin pushed himself forward until he was standing. He walked behind his desk, turning his back on them, and looked out at his sprawling empire. "This is a very expensive procedure, Sarah."

"And you're a very rich man," she replied.

Don looked at McGavin's back, more or less silhouetted against the bright sky. At last, McGavin spoke. "I envy you, Don."

"Why?"

"To have a wife who loves you so much. I understand the two of you have been married for over fifty years."

"Sixty," said Don, "as of two days ago."

"I never..." McGavin began, but then he fell silent.

Don had vague recollections of McGavin's high-profile divorce, years ago, and a nasty court case to try to invalidate the pre-nup.

"Sixty years," McGavin continued, at last. "Such a long time..."

"It hasn't seemed that way," said Sarah.

Don could hear McGavin make a noisy intake of breath and then let it out.

"All right," he said, turning around, his head nodding. "All right, I'll pay for the procedure for both of you." He walked toward them, but remained standing. "So, do we have a deal?"

Sarah opened her mouth to say something, but Don spoke before she could.

"We have to talk about this," he said.

"So let's talk," said McGavin.

"Sarah and I. We have to talk about this alone."

McGavin seemed momentarily peeved, as though he felt they were looking a gift horse in the mouth. But then he nodded. "All right, take your time." He paused, and Don thought he was going to say something stupid like, "But not too much time." But instead he said, "I'll have my driver take you over to Pauli's—finest restaurant in Boston. On me, of course. Talk it over. Let me know what you decide."

Chapter 6

The robot chauffeur drove Sarah and Don to the restaurant. Don got out of the car first and carefully made his way over to Sarah's door, helping her up and out, and holding her arm as they crossed the sidewalk and entered.

"Hello," said the young white woman standing at a small podium inside the door. "You must be Dr. and Mr. Halifax, no? Welcome to Pauli's."

She gave them a hand getting out of their parkas. Fur was back in vogue—the pelts lab-grown, without producing the whole animal—but Sarah and Don were of a generation that had come to frown on fur, and neither could bring themselves to wear any. Their nylon-shelled coats from Mark's Work Wearhouse, his in navy blue, hers beige, looked decidedly out-of-place on the racks in the coat check.

The woman took Don's elbow, and Don took Sarah's, a sideways conga line shuffling slowly to a large booth near a crackling fireplace.

Pauli's turned out to be a seafood restaurant, and even though Don loved

John Masfield's poetry, he hated seafood. Ah, well; doubtless the menu would have some chicken or steak.

There were the usual accoutrements of such places: an aquarium of lobsters, fishing nets hanging on the walls, a brass diver's helmet sitting on an old wooden barrel. But the effect was much more upscale than Red Lobster; here everything looked like valuable antiques rather than garage-sale kitsch.

Once they'd managed to get seated, and the young woman had taken their drink order—two decaf coffees—Don settled back against the soft leather upholstery. "So," he said, looking across at his wife, the crags in her face highlighted by the dancing firelight, "what do you think?"

"It's an incredible offer."

"That it is," he said, frowning. "But . . ."

He trailed off as the waiter appeared, a tall black man of about fifty, dressed in a tuxedo. He handed a menu printed on parchment-like paper bound in leather covers to Sarah, then gave one to Don. He squinted at it. Although this restaurant doubtless had lots of older patrons—they'd passed several on the way to the table—anyone who dined here regularly probably could afford new eyes, and—

"Hey," he said, looking up. "There are no prices."

"Of course not, sir," said the waiter. He had a Haitian accent. "You are Mr. McGavin's guests. Please order whatever you wish."

"Give us a moment," said Don.

"Absolutely, sir," said the waiter, and he disappeared.

"What McGavin's offering is . . .," started Don, then he trailed off. "It's—I don't know—it's crazy."

"Crazy," repeated Sarah, lobbing the word back at him.

"I mean," he said, "when I was young, I thought I'd live forever, but . . ."

"But you'd made your peace with the idea that . . ."

"That I was going to die soon?" he

said, lifting his eyebrows. "I'm not afraid of the D-word. And, yes, I guess I had made my peace with that, as much as anyone does. Remember when Ivan Krehmer was in town last fall? My old buddy from back in the day? We had coffee, and, well, we both knew it was the last time we'd ever see or even speak to each other. We talked about our lives, our careers, our kids and grandkids. It was a . . ." He sought a phrase; found it: "A final accounting."

She nodded. "So often, these last few years, I've thought, 'Well, that's the last time I'll visit this place.'" She looked out at the other diners. "It's not even all been sad. There are plenty of times I've thought, 'Thank God I'll never have to do *that* again.' Getting my passport renewed, some of those medical tests they make you have every five years. Stuff like that."

He was about to reply when the waiter reappeared. "Have we decided yet?"

Not by a long shot, Don thought.

"We need more time," Sarah said. The waiter dipped his head respectfully and vanished again.

More time, thought Don. That's what it was all about, suddenly having more time. "So, so he's talking about, what, rejuvenating you thirty-eight years, so you'll still be around when the next reply is received?"

"Rejuvenating *us*," said Sarah, firmly—or, at least, in what he knew was supposed to be a firm tone; the quaver never quite left her voice these days. "And, really, there's no need to stop at that. That would only take us back to being fifty or so, after all." She paused, took a moment to gather her thoughts. "I remember reading about this. They say they can regress you to any point after your body stopped growing. You can't go back before puberty, and you probably shouldn't go back much earlier than twenty-five, before wisdom teeth have erupted and the bones of the skull have totally fused."

"Twenty-five," said Don, tasting the

number, imagining it. "And then you'd age forward again, at the normal rate?"

She nodded. "Which would give us enough time to receive two more replies from..." She lowered her voice, perhaps surprised to find herself adopting McGavin's term, "from my pen pal."

He was about to object that Sarah would be over a hundred and sixty by the time two more replies could be received—but, then again, that would only be her chronological age; she'd be just a hundred physically. He shook his head, feeling woozy, disoriented. *Just a hundred!*

"You seem to know a lot about this," he said.

She tipped her head to one side. "I read a few of the articles when the procedure was announced. Idle curiosity."

He narrowed his eyes. "Was that all?"

"Sure. Of course."

"I've never even *thought* about living to be over a hundred," he said.

"Of course not. Why would you? The idea of being *ancient*, withered, worn out, infirm, for years on end—who would fantasize about that? But *this* is different."

He looked at her, studying her face in a way he hadn't for some time. It *was* an old woman's face, just as his face, he knew, was that of an old man, with wrinkles, creases, and folds.

It came to him, with a start, that their very first date all those years ago had ended in a restaurant with a fireplace, after he'd dragged her to see the premiere of *Star Trek IV: The Voyage Home*. He recalled how beautiful her smooth features had looked, how her lustrous brown hair had shone in the dancing light, how he'd wanted to stare at her forever. Age had come up then, too, with Sarah asking how old he was. He'd told her he was twenty-six.

"Hey, me, too!" she'd said, sounding pleased. "When's your birthday?"

"October fifteenth."

"Mine was in May."

"Ah," he'd replied, a mischievous tone

in his voice, "an older woman."

That had been so very long ago. And to go back to that age! It was madness. "But... but what would you—would *we*—do with all that time?" he asked.

"Travel," said Sarah at once. "Garden. Read great books. Take courses."

"Hmmmph," said Don.

Sarah nodded, apparently conceding that she hadn't enticed him. But then she rummaged in her purse and pulled out her datacom, tapped a couple of keys, and handed him the slim device. The screen was showing a picture of little Cassie, wearing a blue dress, her blond hair in pigtails. "Watch our grandchildren grow up," she said. "Get to play with our great-grandchildren, when they come along."

He blew out air. To get to attend his grandchildren's college graduations, to be at their weddings. That *was* tempting. And to do all that in robust good health, but...

"But do you really want to attend the funerals of your own children?" he said. "Because that's what this would mean, you know. Oh, I'm sure the procedure will come down in price eventually, but not in time for Carl or Emily to afford it." He thought about adding, "We might even end up burying our grandchildren," but found he couldn't even give voice to *that* notion.

"Who knows how fast the costs will come down?" Sarah said. "But the idea of having decades more with my kids and grandkids is very appealing... no matter what happens in the end."

"Maybe," he said. "Maybe. I—I'm just..."

She reached across the dark polished wood of the table and touched his hand. "Scared?"

It wasn't an accusation from Sarah; it was loving concern. "Yeah, I suppose. A bit."

"Me, too," she said. "But we'll be going through it together."

He lifted his eyebrows. "Are you sure you could stand to have me around for

another few decades?"

"I wouldn't have it any other way."

To be young again. It was a heady thought, and, yes, it was scary, too. But it was also, he had to admit, intriguing. He'd never liked taking charity, though. If the procedure had been something they could have even remotely afforded, he might have been more enthusiastic. But even if they sold their house, sold every stock and bond they owned, liquidated all their assets, they couldn't begin to pay for the treatment for even one of them, let alone for them both. Hell, even Cody McGavin had had to think twice about spending so much money.

This stuff about Sarah being the one and only person who could communicate with the aliens struck Don as silly. But it wasn't as though the rejuvenation could be taken back; once done, it was done. If it turned out that McGavin was wrong about her being pivotal, they'd still have all those extra decades.

"We'd need money to live on," he said. "I mean, we didn't plan for fifty years of retirement."

"True. I'd ask McGavin to endow a position for me back at U of T, or provide some sort of retainer."

"And what will our kids think? We'll be physically younger than them."

"There is that."

"And we'll be doing them out of their inheritance," he added.

"Which was hardly going to make them rich anyway," replied Sarah, smiling. "I'm sure they'll be delighted for us."

The waiter returned, looking perhaps a bit wary of the possibility that he was going to be rebuffed again. "Have we made up our minds?"

Don looked over at Sarah. She'd always been beautiful to him. She was beautiful now, she'd been beautiful in her fifties, she'd been beautiful in her twenties. And, as her features shifted in the light of the dancing flames, he could see her face as it had been at those ages—all those stages of life they'd spent

together.

"Yes," said Sarah, smiling at her husband. "Yes, I think we have."

Don nodded, and turned to the menu. He'd pick something quickly. He did find it disconcerting, though, to see the item descriptions but no accompanying dollar values. *Everything has a price*, he thought, *even if you can't see it*.

Chapter 7

Don and Sarah had had another discussion about SETI, a year before the original Sigma Draconis signal had been detected. They'd been in their late forties then, and Sarah, depressed about the failure to detect any message, had been worried that she'd devoted her life to something pointless.

"Maybe they *are* out there," Don had said, while they went for a walk one evening. He'd gotten religion about his weight a few years before, and they now did a half-hour walk every evening during the good weather, and he used a treadmill in the basement in winter. "But maybe they're just keeping quiet. You know, so as not to contaminate our culture. The Prime Directive, and all that."

Sarah had shaken her head. "No, no. The aliens have an *obligation* to let us know they're there."

"Why?"

"Because they'd be an existence proof that it's possible to survive technological adolescence—you know, the period during which you have tools that could destroy your entire species but no mechanism in place yet to prevent them from ever being used. We developed radio in 1895, and we developed nuclear weapons just fifty years later, in 1945. Is it possible for a civilization to survive for centuries, or millennia, once you know how to make nuclear weapons? And if those don't kill you, rampaging AI or nanotech or genetically engineered weapons might—unless you find some way to survive all that. Well, any civilization whose signals we pick up is almost

certainly going to be much older than we are; receiving a signal would tell us that it's possible to survive."

"I guess," Don said. They'd come to where Betty Ann Drive crossed Senlac Road, and they turned right. Senlac had sidewalks, but Betty Ann didn't.

"For sure," she replied. "It's the ultimate in Marshall McLuhan: the medium is the message. Just detecting it, even if we don't understand it, tells us the most important thing ever."

He considered that. "You know, we should have Peter de Jager over sometime soon. I haven't played go in ages; Peter always likes a game."

She sounded irritated. "What's Peter got to do with anything?"

"Well, what's he best remembered for?"

"Y2K," said Sarah.

"Exactly!" he said.

Peter de Jager lived in Brampton, just west of Toronto. He moved in some of the same social circles as the Halifaxes did. Back in 1993, he'd written the seminal article "Doomsday 2000" for *ComputerWorld* magazine, alerting humanity to the possibility of enormous computer problems when the year 2000 rolled around. Peter spent the next seven years sounding the warning call as loudly as he could. Millions of person-hours and billions of dollars were spent correcting the problem, and when the sun rose on Saturday, January 1, 2000, no disasters occurred: airplanes kept flying, money stored electronically in banks didn't suddenly disappear, and so on.

But did Peter de Jager get thanked? No. Instead, he was excoriated. He was a charlatan, said some, including Canada's *National Post*, in a year-end summation of the events of 2000—and their proof was that nothing had gone wrong.

Don and Sarah were passing Willowdale Middle School now, where Carl was just finishing grade eight. "But what's Y2K got to do with the aliens not signaling their existence?" she asked.

"Maybe they understand how *danger-*

ous it would be for us to know that some races did manage to survive technological adolescence. We got through Y2K because of lots of really hard work by really dedicated people, but once we *were* through it, we assumed that we would have gotten through it *regardless*. Surviving into the year 2000 was taken as—what was your phrase?—"an existence proof" that such survival had been inevitable. Well, detecting alien races who've survived technological adolescence would be taken the same way. Instead of us thinking it was very difficult to survive the stage we're going through, we'd see it as a cakewalk. *They* survived it, so surely we will, too." Don paused. "Say some alien, from a planet around—well, what's a nearby sunlike star?"

"Epsilon Indi," said Sarah.

"Fine, okay. Imagine aliens at Epsilon Indi pick up the television broadcasts from some other nearby star, um . . ."

"Tau Ceti," she offered.

"Great. The people at Epsilon Indi pick up TV from Tau Ceti. Not that Tau Ceti was deliberately signaling Epsilon Indi, you understand; they're just leaking stuff into space. And Epsilon Indi says, hey, these guys have just emerged technologically, and we did that long ago; they must be going through some rough times—maybe the guys on Epsilon Indi can even tell that from the TV signals. And so they say, let's contact them so they'll know it's all going to be okay. And what happens? A few decades later Tau Ceti falls silent. Why?"

"Everybody there got cable?"

"Funny," said Don. "Funny woman. No, they didn't all get cable. They just stopped worrying about somehow surviving having the bomb and all that, and now they're *gone*, because they got careless. You make that mistake once—you tell a race, hey, look, you can survive, 'cause we did—and that race stops trying to solve its problems. I don't think you'd ever make that mistake again."

They'd come to Churchill Avenue, and had turned east, walking by the public school Emily, who was now in grade two, attended. "But they could tell us *how* they survived, show us the answer," said Sarah.

"The answer is obvious," said Don. "You know the least-best-selling diet book of all time? *Losing Weight Slowly by Eating Less and Exercising More.*"

"Yes, Mr. Atkins."

He made his tone one of mock umbrage. "Excuse me! Going for a walk here! Besides, I *am* eating less, and more sensibly, way more sensibly than I was before I started cutting back on carbs. But you want to know what the difference is between me and all the others who lost weight quickly on Atkins, then put it back on as soon as they quit? It's been four years now, and I haven't quit—and I'm never going to. That's the other piece of weight-loss advice no one wants to hear. You can't diet temporarily; you have to make a permanent lifestyle change. I have, and I'm going to live longer for it. There are no quick fixes for anything."

He ceased talking as they crossed Claywood, then began speaking again. "No, the answer is obvious. The way to survive is to stop fighting each other, to learn tolerance, and to put an end to the huge disparity between rich and poor, so that some people don't hate the rest of us so much that they'd do anything, including even killing themselves, to hurt us."

"But we *need* a quick fix," said Sarah. "With terrorists having access to biotech and nuclear weapons, we can't just wait for everyone to get enlightened. You have to solve the problem of high-tech terrorism really quickly—just as soon as it becomes a problem—or no one survives. Those alien races who *have* survived must have found a solution."

"Sure," said Don. "But even if they did tell us their answer, we wouldn't like it."

"Why?"

"Because," he said, "the solution is

that time-honored sci-fi cliché, the hive mind. On *Star Trek*, the reason the Borg absorb everyone into the Collective, I think, is that it's the only safe path. You don't have to worry about terrorists, or mad scientists, if you all think with one mind. Of course, if you do that, you might even lose any notion that there could be other individuals out there. It might never occur to you to even try to contact somebody else, because the whole notion of 'somebody else' has become foreign to your way of thinking. That could explain the failure of SETI. And then if you did encounter another form of intelligent life, perhaps by chance, you'd do exactly what the Borg did: absorb it, because that's the only way you can be sure it'll never hurt you."

"Gee, that's almost more depressing than thinking there are no aliens at all."

"There's another solution, too," said Don. "Absolute totalitarianism. Everyone's still got free will, but they're constrained from doing anything with it. Because all it takes is one crazy person and a pile of antimatter, and—kablooi!—the whole stinking planet is gone."

A car coming toward them beeped its horn twice. He looked up and saw Julie Fein driving by and waving. They waved back.

"That's not much better than the Borg scenario," Sarah said. "Even so, it's so depressing not to have detected anything. I mean, when we first started pointing our radio telescopes at the sky, we thought we'd pick up tons of signals from aliens, and, instead, in all that time—almost fifty years now—not a peep."

"Well, fifty years isn't that long," he said, trying now to console her.

Sarah was looking off into the distance. "No, of course not," she said. "Just most of a lifetime."

Chapter 8

Carl, the elder of Don and Sarah's two children, was known for his theatrics, so

Don was grateful that he didn't spurt coffee all over the table. Still, after swallowing, he managed to exclaim "You're going to do what?" with vigor worthy of a sitcom. His wife Angela was seated next to him. Percy and Cassie—in full, Perseus and Cassiopeia, and, yes, Grandma had suggested the names—had been dispatched to watch a movie in Carl and Angela's basement.

"We're going to be rejuvenated," repeated Sarah, as if it were the most natural thing in the world.

"But that costs—I don't know," said Carl, looking at Angela, as if she should be able to instantly supply the figure. When she didn't, he said, "That costs billions and billions."

Don saw his wife smile. People sometimes thought their son had been named for Carl Sagan, but he wasn't. Rather, he was named for his mother's father.

"Yes, it does," said Sarah. "But we're not paying for it. Cody McGavin is."

"You know Cody McGavin?" said Angela, her tone the same as it would have been if Sarah had claimed to know the Pope.

"Not until last week. But he knew of me. He funds a lot of SETI research." She shrugged a little. "One of his causes."

"And he's willing to pay to have you rejuvenated?" asked Carl, sounding skeptical.

Sarah nodded. "And your father, too." She recounted their meeting with McGavin. Angela stared in open-mouth wonder; she had mostly only known her mother-in-law as a little old lady, not—as the news-sites kept calling her—"the Grand Old Woman of SETI."

"But, even if it's all paid for," said Carl, "no one knows what the long-term effects of—of—what do they call it?"

"A rollback," said Don.

"Right. No one knows the long-term effects of a rollback."

"That's what everyone says about everything new," said Sarah. "No one knew what the long-term effects of low-carb dieting would be, but look at your

father. He's been on a low-carb diet for forty years now, and it's kept his weight, cholesterol, blood pressure, and blood sugar all normal."

Don was embarrassed to have this brought up; he wasn't sure that Angela knew that he used to be fat. He'd started putting on weight during his Ryerson years, and, by the time he was in his early forties, he'd reached 240 pounds—way too much for his narrow-shouldered five-foot-ten frame. But Atkins had taken it off, and kept it off; he had been a trim 175 for decades. While the others had enjoyed garlic mashed potatoes with their roast beef this evening, he'd had a double helping of green beans.

"Besides," continued Sarah, "if I don't do this, nothing else I start today will have any long-term effects—because I won't be around for the long term. Even if twenty or thirty years down the road this gives me cancer or a heart condition, that's still twenty or thirty additional years that I wouldn't have otherwise had."

Don saw a hint of a frown flicker across his son's face. Doubtless he'd been thinking about when his mother had cancer once before, back when he'd been nine. But it was clear he had no comeback for Sarah's argument. "All right," he said at last. He looked at Angela, then back at his mother. "All right." But then he smiled, a smile that Sarah always said looked just like Don's own, although Don himself couldn't see it. "But you'll have to agree to do more babysitting."

After that, everything happened quickly. Nobody said it out loud, but there was doubtless a feeling that time was of the essence. Left untreated Sarah—or Don, for that matter, although no one seemed to care about him—might pass away any day now, or end up with a stroke or some other severe neurological damage that the rejuvenation process couldn't repair.

As Don had learned on the web, a

company called Rejuvenex held the key patents for rollback technology, and pretty much could set whatever price they felt would give their stockholders the best return. Surprisingly, in the almost two years the procedure had been commercially available, fewer than a third of all rollbacks had been for men and women as old as or older than he and Sarah—and over a dozen had been performed on people in their forties, who had presumably panicked at the sight of their first gray hairs and had had a few spare billion lying around.

Don had read that the very first biotech company devoted to trying to reverse human aging had been Michael West's Geron, founded in 1992. It had been located in Houston, which made sense at the time: its initial venture capital had come from a bunch of rich Texas oilmen eager for the one thing their fortunes couldn't yet buy.

But oil was so last millennium. Today's biggest concentration of billionaires was in Chicago, where the nascent cold-fusion industry, spun off from Fermilab, was centered, and so Rejuvenex was based there. Carl had accompanied Don and Sarah on the trip to Chicago. He was still dubious, and wanted to make sure his parents were properly looked after.

Neither Don nor Sarah had ever been to a private hospital before; such things were all but unheard of in Canada. Their country had no private universities, either, for that matter, something Sarah was quite passionate about; both education and health care should be public concerns, she often said. Still, some of their better-off friends had been known to bypass the occasional queues for procedures at Canadian hospitals and had reported back about luxurious facilities that catered to the rich south of the border.

But Rejuvenex's clients were a breed apart. Not even movie stars (Don's usual benchmark for superwealth) could afford their process, and the opulence of

the Rejuvenex compound was beyond belief. The public areas put the finest hotels to shame; the labs and medical facilities seemed more high-tech than even what Don had seen in the recent science-fiction films his grandson Percy kept showing him.

The rollback procedure started with a full-body scan, cataloging problems that would have to be corrected: damaged joints, partially clogged arteries, and more. Those that weren't immediately life-threatening would be addressed in a round of surgeries after the rejuvenation was complete; those that required attention right now were dealt with at once.

Sarah needed a new hip and repairs to both knee joints, plus a full-skeletal calcium infusion; all that would wait until after the rejuvenation. Don, meanwhile, really could use a new kidney—one of his was almost nonfunctional—but once he was rejuvenated, they'd clone one for him from his own cells and swap it in. He'd also need new lenses in his eyes, a new prostate, and on and on; it made him think of the kind of shopping list Dr. Frankenstein used to give Igor.

Using a combination of laparoscopic techniques, nanotech robotic drones injected into their bloodstreams, and traditional scalpel work, the urgent structural repairs were done in nineteen hours of surgery for Sarah and sixteen for Don. It was the sort of tune-up that doctors normally didn't recommend for people as old as they were, since the stress of the operations could outweigh the benefits, and, indeed, they were told that there had been a few touch-and-go moments while work was done on one of Sarah's heart valves, but in the end they came through the various surgeries reasonably well.

Just that would have cost a fortune—and Don and Sarah's provincial health plan didn't cover elective procedures performed in the States—but it was nothing compared to the actual gene therapies, which required the DNA in each of their bodies' trillions of somatic

cells to be repaired. Lengthening the telomeres was a key part of it, but so much more had to be done: each DNA copy had to be checked for errors that had intruded during previous copying, and when they were found—and there were billions of such errors in an elderly human—they had to be fixed by rewriting the strands nucleotide by nucleotide, a delicate and complex process to perform within living cells. Then free radicals had to be bound up and flushed away, regulatory sequences reset, and on and on, a hundred procedures, each one repairing some form of damage.

When it was done, there was no immediate change in either Don or Sarah's appearance. But it would come, they were told, bit by bit, over the next few months, a strengthening here, a firming there, the erasing of a line, the regrowth of a muscle.

And so Don, Sarah, and Carl returned to Toronto, with Cody McGavin again picking up the tab; the flights to and from Chicago had been the only times in his life that Don had flown Executive Class. Ironically, because of all the little surgeries and petty medical indignities, he felt much more tired and worn out than he had prior to beginning all this.

He and Sarah would take twice-daily hormonal infusions for the next several months, and a Rejuvenex doctor would fly up once a week—all part of the service—to check on how their rollbacks were progressing. Don had vague childhood memories of his family's doctor making the odd house call in the 1960s, but this was a degree of medical attention that seemed almost sinful to his Canadian sensibilities.

For years, he'd avoided looking at himself in the mirror, except in the most perfunctory way while shaving. He hadn't liked the way he'd looked back when he was fat, and hadn't liked the way he'd looked recently, either: wrinkled, liver-spotted, tired, *old*. But now, each morning, he examined his face minutely in the bathroom mirror, and tugged at his

skin, looking for signs of new resiliency. He also examined his bald head, checking for new growth. They'd promised him that his hair would come back, and would be the sandy brown of his youth, not the gray of his fifties or the snow white of the fringe that remained in his eighties.

Don had always had a large nose, and it, and his ears, had grown even larger as he'd gotten older; parts made of cartilage continue to get bigger throughout one's life. Once the rollback was complete, Rejuvenex would trim his nose and ears down to the sizes they'd been when he really had been twenty-five.

Don's sister Susan, dead these fifteen years now, had also been cursed by the Halifax family schnoz, and, when she'd been eighteen, after begging her parents for years, they'd paid for rhinoplasty.

He remembered the big moment at the clinic, the unwrapping of the bandages after weeks of healing, revealing the new, petite, retroussé handiwork of Dr. Jack Carnaby, whom *Toronto Life* had dubbed the finest noseman in the city the year before.

He wished there had been some magical moment like that for this, some *ab bah!* revelation, some sudden return to vim and vigor, some *unveiling*. But there wasn't; the process would take weeks of incremental changes, cells dividing and renewing at an accelerated pace, hormone levels shifting, tissues regenerating, enzymes—

My God, he thought. *My God*. There was new hair, an all-but-invisible peach fuzz spreading up from the snowy fringe, conquering the dome, reclaiming territory once thought irretrievably lost.

"Sarah!" shouted Don, and, for the first time in ages, he realized he was shouting without it hurting his throat. "Sarah!" He ran—yes, he veritably *ran*—down the stairs to the living room, where she was seated in the La-Z-Boy, staring at the stone-cold fireplace.

"Sarah!" he said, bending his head low. "Look!"

She came out of whatever reverie she'd been lost in, and although with his head tipped he couldn't see her, he could hear the puzzlement in her voice. "I don't see anything."

"All right," he said, disappointed. "But feel it!"

He felt the cool, loose, wrinkly skin of her fingers touching his scalp, the fingertips tracing tiny paths in the new growth. "My goodness," she said.

He tilted his head back to a normal position, and he knew he was grinning from ear to ear. He'd borne it stoically when he'd started to go bald around thirty, but, nonetheless, he found himself feeling inordinately pleased at this almost imperceptible return of hair.

"What about you?" he asked, perching now on the wide arm of the couch near the La-Z-Boy. "Any signs yet?"

Sarah shook her head slowly and, he thought, a little sadly. "No," said his wife. "Nothing yet."

"Ah, well," he said, patting her thin arm reassuringly. "I'm sure you'll see something soon."

Chapter 9

Sarah would always remember March first, 2009. She had been forty-eight then, a breast-cancer survivor for five years, and a tenured professor at the University of Toronto for ten. She'd been heading down the fourteenth-floor corridor when she heard, just barely, the sound of her office phone ringing. She ran the rest of the way, glad as always to work in a field that never required her to wear heels. Fortunately, she'd already had her key in hand, or she'd never have gotten through the door before the university's voice-mail system grabbed the call. "Sarah Halifax," she said into the beige handset.

"Sarah, it's Don. Have you been listening to the news?"

"Hi, honey. No, I haven't. Why?"

"There's a message from Sigma Draconis."

"What are you talking about?"

"There's a message," Don said again, as if Sarah's difficulty had simply been in hearing the words, "from Sigma Draconis. I'm at work; it's all over the wire services and the Internet."

"There can't be," she said, nonetheless turning on her computer. "I'd have been informed before any public announcement."

"There *is* a message," he repeated. "They want you on *As It Happens* tonight."

"Um, sure. But it's got to be a hoax. *The Declaration of Principles* says—"

"NPR's got Seth Shostak on right now, talking about it. Apparently they picked it up last night, and somebody leaked it."

Sarah's computer was still booting. The handful of musical notes that Windows played on starting up issued from the machine's speakers.

"What does the message say?"

"No one knows. It's a free-for-all, with everybody, everywhere, scrambling to figure it out."

She found herself tapping her fingers rapidly on the edge of her desk and muttering at the computer's slowness. Big icons were filling in on her desktop, and smaller ones were popping up in her system tray.

"Anyway," said Don, "I've got to go. They need me back in the control room. They'll call you for a pre-interview later today. The message is everywhere on the web, including Slashdot. Bye."

"Bye." She put down the phone with her left hand while maneuvering her mouse with her right, and she soon had the message, a vast array of zeros and ones, on screen. Still dubious, she opened three more browser tabs and started searching for information about when and how the message had been received, what was known about it so far, and so on.

There was no mistake. The message was real.

No one was around to hear her speak, but she sagged back in her chair and

said the words anyway, words that had been the mantra of SETI researchers since Walter Sullivan had used them as the title of his famous book: *"We are not alone..."*

"But Professor Halifax, isn't it true that we might *never* be able to figure out what the aliens are saying?" the female host had asked that night, back in 2009, during the *As It Happens* radio interview. "I mean, we share this planet with dolphins, and we can't tell what *they're* saying. How could we possibly understand what someone from another world is trying to say?"

Sarah smiled at Don, who was in the control room on the other side of the window; they'd discussed this before. "First off, there may in fact be no dolphin language, at least not a rich, abstract one like ours. Dolphins have smaller brains relative to their body weight than humans do, and they devote a huge amount of what they do have to echolocation."

"So we might not have figured out their language because there's nothing to figure out?" said the host.

"Exactly. Besides, just because we're from the same planet doesn't necessarily mean we should have more in common with them than with aliens. We actually have very little in common with dolphins. They don't even have hands, but the aliens must."

"Whoa, Professor Halifax. How do you know that?"

"Because they built radio transmitters. They've proven they're a technological species. In fact, they almost certainly live on dry land, again meaning we have more in common with them than with dolphins. You need to be able to harness fire to do metallurgy and all the other things required to make radio. Plus, of course, using radio means understanding mathematics, so they obviously have that in common with us, too."

"Not all of us are good at math," said the host, amiably. "But are you saying

that, by necessity, whoever *sent* the message must have a lot in common with the sort of person who was trying to *receive* it?"

Sarah was quiet for a few seconds, thinking about this. "Well, I—um, yes. Yes, I guess that's so."

Dr. Petra Jones was a tall, impeccably dressed black woman who looked to be about thirty—although, with employees of Rejuvenex, one could never be sure, Don supposed. She was strikingly beautiful, with high cheekbones and animated eyes, and hair that she wore in dreadlocks, a style he'd seen come in and out of fashion several times now. She had arrived for her weekly visit to check up on Don and Sarah, as part of a circuit she did visiting Rejuvenex clients in different cities.

Petra sat down in the living room of the house on Betty Ann Drive and crossed her long legs. Opposite her was a window, one of the two on either side of the fireplace. Outside, the snow had melted; spring was coming. She looked at Sarah, then at Don, then back at Sarah again, and finally, she just said it. "Something has gone wrong."

"What do you mean?" said Don at once.

But Sarah simply nodded, and her voice was full of sadness. "I'm not regressing, am I?"

He felt his heart skip a beat.

Petra shook her head, and beads woven into her dreadlocks made small clacking sounds: "I am so sorry," she said, very softly.

"I knew it," said Sarah. "I—in my bones, I knew it."

"Why not?" Don demanded. "Why the hell not?"

Petra lifted her shoulders slightly. "That's the big question. We've got a team working on this right now, and—"

"Can it be fixed?" he asked. *Please, God, say that it can be fixed.*

"We don't know," said Petra. "We've never encountered anything like this be-

fore." She paused, apparently gathering her thoughts. "We did succeed in lengthening your telomeres, Sarah, but for some reason the new endcap sequences are just being ignored when your chromosomes are being reproduced. Instead of continuing to transcribe all the way up to the end of your DNA, the replicator enzyme is stopping short, at where your chromosome arms used to end." She paused. "Several of the other biochemical changes we introduced are being rejected, too, and, again, we don't know why."

Don was on his feet now. "This is bullshit," he said. "Your people said they knew what they were doing."

Petra flinched, but then seemed to find some strength. She had a slight accent to his ears; Georgia, maybe. "Look," she said, "I'm a doctor; I'm not in PR. We *do* know more about senescence and programmed cell death than anybody else. But we've done fewer than two hundred multidecade rejuvenation procedures on humans at this point." She spread her arms a bit. "This is still new territory."

Sarah was looking down at her hands—her swollen-jointed, liver-spotted, translucent-skinned hands, folded in her lap. "I'm going to stay old." It was a statement, not a question.

Petra closed her eyes. "I am so sorry, Sarah." But then she made her tone a bit brighter, although it sounded forced to Don. "But some of what we did *was* beneficial, and none of it seems to have been detrimental. Didn't you tell me last time I was here that some of your day-to-day physical discomfort is gone?"

Sarah looked at Don, and she squinted, as if trying to make out someone far, far away. He walked over to her and stood next to where she was seated, placing a hand on her bony shoulder. "You must have some idea what caused this," he said sharply to Petra.

"As I said, we're still working on that, but . . ."

"What?" he said.

"Well, it's just that you had breast cancer, Mrs. Halifax . . ."

Sarah narrowed her eyes. "Yes. So? It was a long time ago."

"When we went over your medical history, prior to commencing our procedures, you told us how it was treated. Some chemotherapy. Radiation. Drugs. A mastectomy."

"Yes."

"Well, one of our people thinks that it might have something to do with that. Not with the successful treatment, which you told us about. But he wanted to know if there were any *unsuccessful* treatments you tried before that."

"Good grief," said Sarah. "I don't remember all the details. It was over forty years ago, and I've tried to put the whole thing out of my mind."

"Of course," said Petra, gently. "Maybe we should speak to the doctors involved."

"Our GP from back then is long dead," Don said. "And the oncologist treating Sarah was in her sixties. She must be gone by now, too."

Petra nodded. "I don't suppose your old doctors transferred records to your new doctor?"

"Christ, how should we know?" said Don. "When we changed doctors we filled out medical histories, and I'm sure we authorized the handing over of files, but . . ."

Petra nodded again. "But this was in the era of paper medical records, wasn't it? Who knows what's become of them, after all these years? Still, the researcher at our facility looking into this uncovered that about that time—early 2000s, right?—there were some interferon-based cancer treatments here in Canada that weren't ever approved by the FDA in the States; that's why we didn't really know about them. They're long off the market; better drugs came along by 2010. But we're trying to find a supply of them somewhere, so that we can run some tests. He thinks that if you had such a treatment, it might be what's

caused our process to fail, possibly because it permanently eliminated some crucial commensal viruses."

"Jesus, you should have screened more carefully," Don said. "We could sue you."

Petra rallied a bit and looked up at him defiantly. "Sue us for what? A medical procedure that you didn't pay for that had no adverse effect?"

"Don, please," said Sarah. "I don't want to sue anyone. I don't . . ."

She trailed off, but he knew what she'd been about to say: "I don't want to waste what little time I have left on a lawsuit." He stroked her shoulder reassuringly. "All right," he said. "All right. But can't we try again? Maybe another round of treatments? Another attempt at rolling back?"

"We *have* been trying again," said Petra, "with tissue samples taken from your wife. But nothing is working."

He felt bile climbing his throat. God damn—God damn *everyone*. Cody McGavin, for bringing this crazy idea into their lives. The people at Rejuvenex. The bloody aliens on Sigma Draconis II. They could all go to hell.

"This is ridiculous," said Don, shaking his head back and forth. He lifted his hand from Sarah's shoulder, and then clasped both his hands behind his back and started pacing the length of the narrow living room, the room that had been home to him and his wife, the room his children had first learned to crawl in, the room that held so much history, so many memories—memories that he and Sarah had shared, decade after decade, good times and bad, thick and thin.

He took a deep breath, let it out. "I want you to stop the process for me, then," he said, his back briefly to the two women.

"Dear, no," said Sarah. "Don't do that."

He turned around and started pacing toward them. "It's the only thing that makes sense. I never wanted this in the

first place, and I sure as hell don't want it if you're not getting it, too."

"But it's a blessing," said Sarah. "It's everything we talked about: seeing our grandchildren grow up; seeing *their* children. I can't—I *won't*—let you give that up."

He shook his head. "No. I don't want it. Not anymore." He stopped walking, and looked directly at Petra. "Undo it."

Petra's brown eyes were wide. "I can't. We can't."

"What do you mean, you can't?" said Don.

"Your treatment has been *done*," Petra said. "Your telomeres are lengthened, your free radicals are flushed, your DNA has been repaired, and on and on. There's no way to undo it."

"There must be," he said.

Petra lifted her shoulders philosophically. "There hasn't been a lot of research funding for finding ways to shorten the human lifespan."

"But you must be able to arrest the rejuvenation, no? I mean, right, I understand that I can't go back to being eighty-seven physically. Okay, fine. I'm—what?—I suppose I look about seventy now, right? Just stop the rollback here." He pointed his index finger straight down, as if marking a spot. Seventy he could live with; that wouldn't be so bad, wouldn't be an insurmountable gulf. Why, old Ivan Krehmer, he was married to a woman fifteen years younger than himself. Offhand, Don couldn't think of a case in their social circle where the woman was a decade and a half older than the man, but surely these days that was common, too.

"There's no way to stop it early," said Petra. "We hard-coded into the gene therapy how far back the rollback will go. It's inexorable once begun. Each time your cells divide, you'll get physically younger and more robust until the target is reached."

"Do another round of gene therapy, then," Don said. "You know, to countermand—"

"We've tried that with lab animals," Petra said, "just to see what happens."

"And?"

She shrugged her shoulders. "It kills them. Cell division comes to a complete halt. No, you have to let the rollback play out. Oh, we *could* cancel the planned follow-up surgeries—fixing your teeth, your knee joints, getting you that new kidney once you're strong enough to stand going under the knife. But what would be the point of that?"

Don felt his pulse racing. "So I'm still going to end up physically twenty-five?"

Petra nodded. "It'll take a couple of months for the rejuvenation to finish, but when it does, that'll be your biological age, and then you'll start aging forward again from that point, at the normal rate."

"Jesus," he said. *Twenty-five*. With Sarah staying eighty-seven. "Good Jesus Christ."

Petra was looking shell-shocked, and she was slowly, almost imperceptibly, shaking her head back and forth. "What?" demanded Don.

The doctor looked up, and it seemed to take her eyes a moment to focus. "Sorry," she said. "I just—well, I just never thought I'd end up having to apologize for giving someone another sixty or seventy years of life."

Don crouched down next to his seated wife. How excruciating doing that would have been just a short time ago—and yet it gave him no pleasure now to be able to do it with ease. "I am sorry, honey," he said. "I am so sorry."

But Sarah was shaking her head. "Don't be. It's going to be all right. You'll see."

How could it be all right? he wondered. They'd spent their lives in synch, born the same year, growing up with the same events in the background. Both remembered precisely where they were when Neil Armstrong set foot upon the moon during the year they'd each turned nine. Both had been teenagers when Watergate happened; in

their twenties when the Berlin Wall fell; in their thirties when the Soviet Union collapsed; in their forties for the first detection of alien life. Even before they'd met, they'd been marching through the stages of life together, jointly aging, and improving, like two bottles of wine of the same vintage.

Don's head was swimming, and so, it seemed, was his vision. Sarah's face appeared blurred, the tears in his eyes doing what Rejuvenex's sorcery couldn't, erasing her wrinkles, smoothing out her features.

Chapter 10

Like most SETI researchers, Sarah had worked late many nights after that first alien transmission had been received back in 2009. Don had come to see her in her office at the University of Toronto on one of those evenings, after he'd finished his work at the CBC.

"Anybody home?" he'd called out.

Sarah had swung around, smiling, as he came through the door carrying a red-and-white Pizza Hut box. "You're an angel!" she crowed. "Thank you!"

"Oh," he said. "Did you want something, as well?"

"Pig! What did you get?"

"A large Pepperoni Lover's . . . 'cause, um, I like pepperoni, and we're lovers . . ."

"*Awww*," said Sarah. She actually preferred mushrooms, but he couldn't stand them. Coupling that with his dislike for fish had given rise to the little speech she'd listened politely to him give on numerous occasions, a pseudo-justification that he thought was witty for his eating choices: "You should only eat food that's as evolved as you are. Only warm-blooded animals—mammals and birds—and only photosynthesizing plants."

"Thanks for coming by," she said, "but what about the kids?"

"I called Carl, told him to order a pizza for him and Emily. Said he could take some money out of my nightstand."

"When Donald Halifax parties, every-

ANALOG

body parties," she said, smiling.

He was looking around for somewhere to set the pizza box. She leapt to her feet and moved a globe of the celestial sphere off the top of a filing cabinet, setting it on the floor. He placed the box where the globe had been and opened its lid. She was pleased to see some steam rising. Not too surprising; the Hut was just up on Bloor Street.

"So, how's it going?" he asked. This wasn't the first time he'd brought food to her office. He kept a plate, knife, and fork in one of the office cupboards, and he got them now. Sarah, meanwhile, pulled out a piece of pizza, severing the cheesy filaments with her fingers.

"It's a race," she said, sitting down in the chair in front of her workstation. "I'm making progress, but who knows how it compares to what everyone else is achieving? I mean, sure, there's a lot of sharing of notes going on online, but I doubt anyone is revealing everything yet."

He found the other office chair—a beat-up folding one—and sat next to her. She was used to the way her husband ate pizza, but couldn't actually say she *liked* it. The crust wasn't part of his diet—of course, the greasy Pizza Hut deep-dish crust probably shouldn't be part of *anyone's* diet, although she found it impossible to resist. He got the toppings off with a fork, swirling it in the molten cheese almost as though he were eating spaghetti. He also ate sandwiches a similar way, digging out the fillings with cutlery while leaving the bread behind.

"Anyway, we'd always expected that math would be the universal language," Sarah continued, "and I guess it is. But the aliens have managed something with it that I wouldn't have thought possible."

"Show me," Don said, moving his chair closer to her workstation.

"First, they establish a pair of symbols that everybody working on this agrees serve as brackets, containing other

things. See that sequence there?" She pointed at a series of blocks on her computer screen. "That's the open bracket, and that one there"—pointing at another place on the screen—"is the closing bracket. Well, I've been doing a rough-and-ready transliteration of everything as I go along—you know, rendering it in symbols we use. So, here's what the first part of the message says." She flipped to another window. It was displaying this:

```
{ } = 0
{ * } = 1
{ ** } = 2
{ *** } = 3
{ **** } = 4
{ ***** } = 5
{ **** * } = 6
{ ***** } = 7
{ ***** } = 8
{ ***** } = 9
```

"See how clever they are?" said Sarah. "The brackets let us tell at a glance that there's nothing in the first set. And see what they're doing? Establishing digits for the numbers zero through nine—the aliens are using base-ten, which may mean they've got the same number of fingers we have, or it might just mean that they've decoded some of our TV, and have seen that that's how many fingers we've got. Oh, and notice that this chart gives us their equals sign, too."

He got up and helped himself to another slice; when you skipped the crust, you went through pizza awfully quickly.

"Anyway," she continued, "they immediately give us the basic mathematical operators. Again, I've rendered them in familiar notation. She rotated the wheel on her mouse, and this scrolled into view:

```
[Question] 2+3
[Answer] 5
```

```
[Question] 2-3
[Answer] -1
```

[Question] 2*3

[Answer] 6

[Question] 2/3

[Answer] 0.6&

"See what they've done here? They've established a symbol for 'question,' and another for 'answer.' And they've also established a symbol for a decimal place, and a symbol for repeating indefinitely, which I've shown as that 'and' thingy."

"Ampersand," said Don, helpfully.

She gave him an *I-knew-that* scowl, and went on. "Next up, they give us a symbol for 'the relationship between,' which I've shown as a colon, and that lets us get a bunch of other concepts." She made this appear:

[Question] 2/3 : 0.6&

[Answer] =

[Question] 5 : 3

[Answer] >

[Question] 9 : 1

[Answer] >>

[Question] 3 : 5

[Answer] <

[Question] 1 : 9

[Answer] <<

[Question] 1 : -1

[Answer] [opposite]

"See?" she said. "We're getting into judgment calls. Nine is judged to be not just greater than one but *much* greater than one, and one, in turn, is much less than nine. Next they give us their symbols for correct and incorrect." This appeared on screen:

[Question] 2+5

[Answer] 7 [correct]

[Question] 3*3

[Answer] 9 [correct]

[Question] 8-3

[Answer] 6 [incorrect]

"And then," said Sarah, "things get really exciting."

"I can hardly contain myself," Don said.

She whapped him lightly on the arm, and nibbled at her own piece of pizza before changing the screen. "This came later in the message. Look."

[Question] 8/12

[Answer 1] 4/7 [incorrect]

[Answer 2] 4/6 [correct][alpha]

[Answer 3] 2/3 [correct][beta]

"See what they're saying there? I've assigned Greek letters to the two new symbols they're establishing. Can you puzzle out what alpha and beta mean?"

To his credit, he stopped shoveling cheese and pepperoni into his mouth and studied the screen carefully.

"Welllll," he said at last, "both answer two and answer three are correct, but, um, well, answer three is *more* correct, right? 'Cause, I mean, they've reduced the fraction."

"Bravo! That's exactly right! Now, think about that: they've just given us a way to express some very powerful concepts." She touched a key, and the terms *alpha* and *beta* were replaced with words:

[Question] 8/12

[Answer 1] 4/7 [incorrect]

[Answer 2] 4/6 [correct][bad]

[Answer 3] 2/3 [correct][good]

"That is, they've given us a term for distinguishing between an answer that, while technically correct, isn't preferable from one that *is* preferable—distinguishing a bad answer from a good one. And, just to drive home the point that they *are* making that distinction—that these terms should be translated as polar opposites—they give us this."

[Question] [bad] : [good]

[Answer] [opposite]

Sarah translated. "What is the relationship between 'bad' and 'good'? Why, they're opposites, just like one and negative one, as we saw before. They're saying these terms should be treated as actual opposites, in a way that 'right' and 'more right,' which would have been the other possible way of translating alpha and beta, aren't."

"Fascinating," he said.

She touched her mouse, and a new display appeared. "Now, what about things that aren't clear cut? Well, try this. What does *gamma* mean?"

{ 3 5 7 11 13 & } = [gamma]

"Odd numbers?" he said. "Every other number?"

"Look again. There's no nine."

"Oh, right. Oh, and, um, hey, there's that 'and' thingy again."

"Amperсанд," said Sarah, imitating Don's helpful tone from earlier. He grinned. "Right," she said, "but I'll give you a hint—something I gleaned from other examples. When the ampersand is right up against another digit, it means that *digit* is repeated forever. But if there's a space before it—a little gap in the transmission, as there is here—I think it means that this *sequence* goes on forever."

"Three, five, seven, eleven, thirteen..."

"I'll give you another hint. The next number in the sequence would be seventeen."

"Um, ah..."

"They're primes," she said. "*Gamma* is their symbol for prime numbers."

"Ah. But why start with three?"

She was grinning broadly now. "You'll see. This is the beauty part." She darted her mouse around. "There's a little more set theory, which I won't bore you with, that establishes a symbol for 'belongs to this set,' and then we get this..."

[Question] 5 [belongs to] [prime numbers]

[Answer] [correct]

"Does five belong to the set of prime numbers—or, more colloquially, the question is, 'Is five a prime number?' And the answer is yes; indeed, five was one of the sample numbers we used in naming the set 'prime numbers.'"

She made another similar Q&A pair appear:

[Question] 4 [belongs to] [prime numbers]

[Answer] [incorrect]

"Is four a prime number?" said Sarah, interpreting. "No."

She rotated her mouse's wheel again:

[Question] 3 [belongs to] [prime numbers]

[Answer] [correct]

"Is three prime? Yup, sure is. And what about two? Ah, well, let's have a look." More mouse movements, and this appeared:

[Question] 2 [belongs to] [prime numbers]

[Answer 1] [correct][good]

[Answer 2] [incorrect][good]

[Answer 3] [delta]

"Huh?"

"My precise reaction," said Sarah, smiling.

"So what's delta?" Don said.

"See if you can figure it out. Look at answer one and answer two for a moment."

He frowned. "Hey, wait. They can't both be good answers. I mean, two *is* a prime number, so saying that it isn't

can't be a good answer."

She smiled cryptically. "They give exactly the same three answers for the number one," she said, scrolling the screen.

[Question] 1 [belongs to] [prime numbers]

[Answer 1] [correct][good]
[Answer 2] [incorrect][good]
[Answer 3] [delta]

"Again, that's gibberish," he said. "One either is or isn't prime. And, well, it *is*, isn't it? I mean, a prime is a number that's only evenly divisible by itself or one, right?"

"Is that what they taught you at Humberside Collegiate? We *used* to define one as a prime; you'll see it called such in some old math books. But these days, we don't. Primes are generally thought of as numbers that have precisely two whole-number factors, themselves and one. One has only one whole-number factor, and so isn't a prime."

"Seems rather arbitrary," said Don.

"You're right. It *is* a debatable point. One is definitely an odd-ball as primes go. And two—well, it's not an *odd*-ball; it's an *even*-ball. That is, it's the only even prime number. You could just as arbitrarily define the set of primes as all *odd* numbers that have precisely two whole-number factors. If you did it that way, then two isn't a prime."

"Ah."

"See? That's what they're conveying. Delta is a symbol that means, I think, 'It's a matter of opinion.' Neither answer is *wrong*; it's just a matter of personal preference, see?"

"That's fascinating."

She nodded. "Now, the next part of the message is really interesting. Elsewhere, they established symbols for 'sender' and 'recipient'—or 'me,' the person sending the message, and 'you,' the person receiving it."

"Okay."

"And with those," said Sarah, "they get down to the nitty gritty. Look at this." Her display changed:

[Question] [good] : [bad]

[Answer] [sender] [opinion]
[good] >> [bad]

"See? The question is, what's the relationship between good and bad. And the response from the sender, who had said previously, when discussing factual matters, that good is the *opposite* of bad, now says something quite a bit more interesting: good is *much greater than* bad—a significant philosophical statement."

"Does not your sacred book promise that good is stronger than evil?"

Sarah felt her eyes go wide. "You're quoting the Bible?"

"Um, actually, no. That's *Star Trek*. Second season, 'The Omega Glory.'" He shrugged sheepishly. "Yes, it is written: good shall always destroy evil."

Sarah shook her head in loving despair. "You'll be the death of me yet, Donald Halifax."

Chapter 11

"McGavin Industries," said a crisp, efficient female voice. "Office of the president."

For once, Don wished he did have a picture phone; for all he knew, he was talking to a robot. "I'd like to speak to Cody McGavin, please."

"Mr. McGavin is unavailable. May I ask who's calling?"

"Yes. My name is Donald Halifax."

"May I ask what this is about?"

"I'm the husband of Sarah Halifax."

"Ah, yes. The SETI researcher, no?"

"That's right."

"What can I do for you, Mr. Halifax?"

"I need to talk to Mr. McGavin."

"As you might imagine, Mr. McGavin's schedule is very full. Perhaps there's something I can help you with?"

Don sighed, beginning to get it. "How

many layers deep am I?"

"I'm sorry?"

"How many layers between you and McGavin? If I give you a message, and you decide it's worth passing on, it doesn't go to McGavin, does it?"

"Not normally, no. I'm the receptionist for the president's office."

"And your name is?"

"Ms. Hashimoto."

"And who do you report to?"

"Mr. Harse, who is the secretary to Mr. McGavin's secretary."

"So I have to get through you, then the secretary's secretary, then the secretary, before I get to McGavin, is that right?"

"We do have to follow procedures, sir. I'm sure you understand that. But of course things can be escalated quickly, if appropriate. Now, if you'll just tell me what you need . . . ?"

Don took a deep breath, then let it out. "Mr. McGavin paid for my wife and me to undergo rejuvenation treatments—you know, rollbacks. But it hasn't worked for my wife, only for me. The doctor from Rejuvenex says nothing can be done, but maybe if she had a request directly from Mr. McGavin. Money talks. I know that. If he indicated he was dissatisfied, I'm sure—"

"Mr. McGavin has had a full report on this."

"Please," Don said. "Please, my wife . . . my wife is going to die."

Silence. His words were probably more brutally honest than the receptionist to the secretary to the secretary to the president was used to hearing.

"I am sorry," Ms. Hashimoto said with what sounded like genuine regret.

"Please," he said again. "Surely whatever report he's seen came from Rejuvenex, and they've doubtless put a spin on it. I want him to understand what we—what Sarah—is going through."

"I'll let him know you called."

No, you won't, he thought. *You'll just pass it on to the next layer.* "If I could just talk to Mr. McGavin, just for a min-

ute. I just . . ." He hadn't begged for anything for decades—not since . . .

It hit him, just then. It hit him like a sucker punch to the gut.

Forty-five years ago. The oncology ward at Princess Margaret. Dr. Gottlieb talking about experimental therapies, about things that were new and untested.

And Don begging her to try them on Sarah, to try anything that might save her. The details were lost to time, but he did now recall the interferon treatment, not approved for use in the States. Gottlieb might have agreed to try it because of his begging, his insistent demands that she do everything that might help.

The experimental treatment had failed. But now, four decades on, its lingering effects were blocking another treatment, all—he swallowed hard—because of him.

"Mr. Halifax?" said Ms. Hashimoto. "Are you still there?"

Yes, he thought. *Yes, I'm still here. And I'll still be here for years to come, long after Sarah's gone.* "Yes."

"I do understand that you're upset, and, believe me, my heart goes out to you. I'll flag this double-red. That's the best I can do. Hopefully someone will get back to you shortly."

Just as he had all those many years ago, when Sarah had been trying to translate the first Dracon message, Don stopped by from time to time to see how she was faring with decrypting the current one. But instead of working at the university, she was struggling with this one in the study—the upstairs room that had once been Carl's.

The Dracons' original message, the one picked up in 2009, had been divided into two parts: a primer, explaining the symbolic language they were using, and the meat of the message—the MOM, as it rapidly came to be known—which used those symbols in baffling ways. But eventually Sarah had figured out the purpose of the MOM, and a re-

ply had been sent.

This second message from the aliens also had two parts. But in this case, the beginning was the explanation of how to decrypt the rest, assuming the right decryption key could be provided, and the rest, well, that was anybody's guess. Because it *was* encrypted, not even a single symbol that had been established in the original message was visible in the second part of this one.

"Maybe the aliens are responding to one of the unofficial responses," Don said, late one evening, leaning against the study's doorway, hands crossed in front of his chest. "I mean, even before you sent the official reply, didn't thousands of people send their own unofficial responses to the Dracons?"

Sarah looked ancient, almost ghostly, in the glow from her magphotic monitor, her thin white hair backlit from his perspective. "Yes, they did," she said.

"So maybe the decryption key is something that was in one of *those* messages," he said. "I mean, I know you worked very hard on it, but maybe the Dracons weren't interested in the official SETI-team response. Whoever they intended to have read their latest message might already have done so."

Sarah shook her head. "No, no. The current Dracon message *is* a response to our official reply. I'm sure of it."

"That might just be wishful thinking," he said gently.

"No, it's not. We put a special header at the top of the official reply—a long numeric string, to identify that message. That's one of the reasons we didn't post the entire reply we sent on the web. If we had, everyone would have the header, which would have defeated its purpose. The header was like an official letterhead, uniquely identifying the response we sent on behalf of the whole planet. And this reply to our response references that header."

"You mean it quotes it?" he asked. "But, then, doesn't everybody have it now? Any Tom, Dick, or Harry could

send a new message to the Dracons and have it look official."

Her wrinkled features shifted in the cold glow as she spoke. "No. The Dracons understood that we were trying to provide a way to distinguish official responses from unofficial ones. They obviously grasped that we didn't want everyone who managed to detect their latest message to know what the header was. So the Dracons quoted every other digit from it, making clear to us that they were responding to the official reply, but without giving away what had distinguished the official reply in the first place."

"Well, there's your answer," Don said, quite pleased with himself. "The decryption key must be the *other* digits from the header, the ones the Dracons didn't echo back."

Sarah smiled. "First thing we tried. It didn't work."

"Oh," he said. "It was just a thought. Are you coming to bed?"

She looked at the clock. "No, I—" She stopped herself, and Don's stomach knotted. Perhaps she'd been about to say *I don't have time to waste on sleeping*. "I'm going to struggle with this some more," she finished. "I'll be along in a bit. You go ahead."

Don called McGavin's office four more times without any luck, but finally his datacom rang. His ring tone was the five notes from a forgotten film called *Close Encounters of the Third Kind*, the sort of aliens-come-to-Earth story that seemed quaintly passé now. He looked at the caller ID. It said "McGavin, Cody"—not "McGavin Robotics," but the actual man's name.

"Hello?" Don said eagerly, as soon as he'd flipped his datacom open.

"Don!" said McGavin. He was somewhere noisy and was shouting. "Sorry to be so long getting back to you."

"That's all right, Mr. McGavin. I need to talk to you about Sarah."

"Yes," said McGavin, still shouting.

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"I'm sorry, Don. I've been briefed on all this. It's just awful. How is Sarah holding up?"

"Physically, she's okay. But it's tearing us both apart."

His tone was as gentle as one's could be when shouting. "I'm sure."

"I was hoping you could speak to the people at Rejuvenex."

"I already have, repeatedly and at length. They tell me there's nothing that can be done."

"But there must be. I mean, sure, Rejuvenex has tried all the standard things, but there's got to be a way to make the rollback work for Sarah if you—"

He stopped talking, which was probably just as well. He'd been about to say, "if you just throw enough money at it." But McGavin wasn't listening. Don could hear him saying something to someone else; from the sounds of it, he'd placed a fingertip over his datacom's mike and was talking to a flunky standing beside him. At last McGavin came back on. "They're working on it, Don, and I've told them to spare no expense. But they're totally stumped."

"They thought maybe an experimental cancer drug was the culprit."

"Yes, they told me that. I've authorized them to spend whatever is necessary to try to get hold of a supply of it, or to synthesize it from scratch. But the researchers I've spoken to think the damage is irreversible."

"They've got to keep trying. They can't give up."

"They won't, Don. Believe me, this is a huge problem for them. It's going to affect their stock price, if word gets out, unless they can find a solution."

"If you hear anything," Don said, "please, let me know at once."

"Of course," said McGavin. "But . . ."

But don't have unrealistic hopes; that was the implicit comment. McGavin had probably seen only an executive summary of the longer report Don had now pried out of Rejuvenex, but the bottom line would have been the same: no solu-

tion likely in the near future.

"Anyway," continued McGavin, "if there's anything Sarah needs to help with the decryption work, or if there's anything either you or she needs for anything else, just let me know."

"She needs to be rolled back."

"I *am* sorry, Don," McGavin said. "Look, I've got to get on a plane. But we'll keep in touch, okay?"

Chapter 12

Back in 2009, those who were part of the formal SETI endeavor had set up a newsgroup to share their progress in figuring out what the various parts of that first, original alien radio message said. It was rumored that the Vatican astronomers were working full-time on trying to translate the message, too, as was, supposedly, a team at the Pentagon. Hundreds of thousands of amateurs were taking a crack at it, as well.

Besides the symbolic-math stuff, parts of the original message turned out to be bitmap diagrams; a researcher in Calcutta was the first to realize that. Someone in Tokyo chimed in shortly thereafter, demonstrating that many of the block-graphic diagrams were actually frames in short animated movies. A new symbol in the last frame of each movie was presumably the word to be used henceforth for the concept that had been illustrated: "growth," "attraction," and so on.

The message also contained a lot about DNA—and, yes, there was no doubt that that was what it was, for its specific chemical formula was given. Apparently it was also the hereditary molecule on Sigma Draconis II—which immediately revived old debates about panspermia, the notion that life on Earth had begun when microorganisms from outer space had chanced to land here. The Dracons, some said, might be our very distant cousins.

The message also contained a discussion of chromosomes, although it took a biologist—in Beijing, as it happened—to recognize that that's what was being

talked about, since the chromosomes were shown as rings, rather than long strings. Apparently, Sarah had learned, bacteria had circular chromosomes, and were essentially immortal, being able to divide forever. The innovation of breaking the circle to make shoelace-like chromosomes had led to the development, at least on Earth, of telomeres, the protective endcaps that diminished each time a cell divided, leading to programmed cell death. No one could say whether the senders had ringlike chromosomes themselves, or whether they were just depicting what they guessed to be either the universal ancestral or most-common kind. On Earth, in terms of biomass and number of individual organisms, chromosomal rings outnumbered the shoelace kind by orders of magnitude.

Once that piece of the puzzle was solved, a bunch of people simultaneously posted that the next set of symbols outlined various stages of life: separate gametes, conception, pre-birth growth, birth, post-birth growth, sexual maturity, the end of reproductive capability, old age, and death.

Lots of fascinating stuff, to be sure, but all of it seemed to be prologue, just a language lesson establishing a vocabulary. None of those early bits, except the tantalizing sample phrase that good was much greater than bad, seemed to actually *say* anything of substance.

But there was lots of message left—the MOM, the meat of the message, a mishmash of symbols and concepts that had been established earlier, each one tagged with several numbers. Nobody could make sense of it.

The breakthrough came on a Sunday evening. At *Chez Halifax*, Sunday nights were Scrabble nights, when Don and Sarah sat on opposites sides of the dining-room table, the fancy turntable set that Sarah had bought him many Christmases ago between them.

Sarah didn't like the game nearly as much as Don did, but she played it to

make him happy. He, meanwhile, had less fondness for bridge than she did—or, truth be told, for Julie and Howie Fein, who lived up the street—but he dutifully joined Sarah in a game with them once a week.

They were getting near the end of the Scrabble match; fewer than a dozen tiles were left in the drawstring bag. Don, as always, was winning. He'd already managed a bingo—Scrabble-speak for playing all seven of one's letters in a single turn—making the improbable *wanderoos* by building on his previous *de*, one of the many two-letter combos that Scrabble accepted as a word but that Sarah, in all of her forty-eight years, had never seen anyone actually use *as* a word. Don was an expert in what she called Scrabble babble: he'd memorized endless lists of obscure words, without bothering to learn their meanings. She'd given up long ago challenging any string of letters he played. It was always in the *Official Scrabble Players Dictionary*, even if her trusty *Canadian Oxford* didn't have it. Still, it was bad enough when he played something like *muzjik*, as he had just now, with both a Z and a J, but to get it on a triple-word score, and—

And suddenly Sarah was on her feet.

"What?" said Don, indignant. "It's a word!"

"It's not just the symbol, it's where it appears!" She was heading out of the dining room, through the kitchen, and into the living room.

"What?" he said, getting up to follow her.

"In the message! The part that doesn't make sense!" She was speaking as she moved. "The rest of the message defines an . . . an *idea*-space, and the numbers are coordinates for where the symbols go within it. They're relating concepts to each other in some sort of three-dimensional array . . ." She was running down the stairs to the basement, where, back then, the family computer had been kept. He followed. Sixteen-year-old Carl was seated in front of the bulky

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CRT monitor, headphones on, playing one of those damned first-person-shooter games that Don so disapproved of. Ten-year-old Emily, meanwhile, was watching *Desperate Housewives* on TV.

"Carl, I need the computer—"

"In a bit, Mom. I'm at the tenth level—"

"Now!"

It was so rare for Sarah to yell that her son actually did get up, relinquishing the swivel chair. "How do you get out of this damn thing?" Sarah snapped, sitting down. Carl reached over his mother's shoulder and did something with the mouse. Don, meanwhile, turned down the volume on the TV, earning him a petulant "Hey!" from Emily.

"It's an X-Y-Z grid," Sarah said. She opened Firefox, and accessed one of the countless sites that had the Dracon message online. "I'm sure of it. They're defining the placement of terms."

"On a map?" Don said.

"What? No, no, no. Not on a map—in space! It's like a 3D page-description language. You know, like Postscript, but for documents that don't just have height and width but depth as well." She was

pounding rapidly at the keyboard. "If I can just figure out the parameters of the defined volume, and . . ."

More keystrokes. Don and Carl stood by, watching in rapt attention. "Damn!" said Sarah. "It's not a cube . . . that'd be too easy. A rectangular prism then. But what are the dimensions?"

The mouse pointer was darting about the screen like a rocket piloted by a mad scientist. "Well," she said, clearly just talking to herself now, "if they're not integers, they might be square roots . . ."

"Daddy . . . ?"

He turned around. Emily was looking up at him with wide eyes. "Yes, sweetheart?"

"What's Mommy doing?"

He glanced back. Sarah had a graphing program running; he suspected she was now glad they'd sprung for the high-end video card that Carl had begged for so he could play his games.

"I think," Don said, turning back to his daughter, "that she's making history." ■

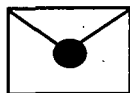
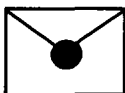
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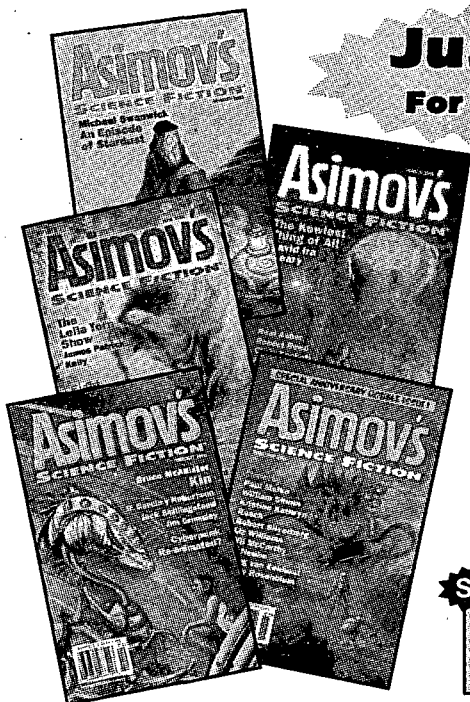
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The Great Sumatran Earthquakes of 2004-5

Richard A. Lovett

Each year, the world experiences about 1,700 earthquakes large enough to cause damage (magnitude 5.0 or greater). And thanks to global seismic networks and instant-news services, it's possible to hear about them all. This means that most people are at least passingly familiar with the earthquake-magnitude scale. But, while we know it's logarithmic, we don't easily realize how much that compresses the scale: only a few points spell the difference between the gurgling of lava beneath a volcano and a major catastrophe.

Nowhere is this more obvious than with the approximately one-point range that differentiates really big earthquakes from truly colossal ones. Alaska's 2002 "Denali" quake, for example, was a 7.9 whose effects were felt as far away as California. But the world sees temblors

of that magnitude about once every two years.¹

Go just one more point up the scale, though, and quakes get rarer (thank goodness). So rare, in fact, that in the interval from 1960 to 2004, there had been only two. One (estimated at magnitude 9.5) was offshore from Chile in 1960. The other (officially estimated at 9.2, but now thought to have been bigger) was Alaska's 1964 "Good Friday" quake. Other than those two, there had been only one temblor bigger than 8.5.²

Then in 2004, on the day after Christmas (a holiday known to the British as Boxing Day), the Indonesian island of Sumatra was hit by a quake nearly as large as Alaska's Good Friday megquake.

Everyone knows the story. The offshore quake set up a tsunami that swept the Indian Ocean, killing 300,000 peo-

¹ From 1981 through 2005, there were eighteen temblors of magnitude 8.0 or greater.

ple and wreaking unimaginable damage. Lesser known is the fact that three months later, on March 28, 2005, the second-largest earthquake in 40 years (magnitude 8.6) hit another portion of the same fault zone. It failed to make major headlines only because this one did not create a substantial tsunami.

The human story of the Boxing Day earthquake is well known. But the scientific story is just beginning to be revealed because the great quake of December 26 and its March 28 successor were the first mega-quakes to be studied with the tools of modern geophysics.

Tiny Squiggles

Seismometers have been around for a long time, but in the 1960s, their data were crude by present standards. When the Chilean and Alaskan quakes hit, you could tell that something major had happened, but many of the details were lost. "Today, you can see all the aftershocks," says Jeffrey Park, a professor of geology and geophysics at Yale University.³

The problem was that early seismometer traces were made with mechanical styluses—and ink lines have finite width. Tiny vibrations merely make them slightly fuzzy.

Today's instruments record their readings electronically, allowing researchers to see enormous detail. It's like using a mechanical stylus on a 600-foot-wide roll of paper. One newly discovered detail is that the Boxing Day quake made the Earth ring like a bell, with slowly dampening reverberations that contin-

ued for months.

Other instruments revealed that the quake rearranged landmasses all over the globe (albeit by as little as 0.1 millimeters) and slightly altered the Earth's axis of rotation.

It was also possible to watch the event from space.

The earthquake itself wasn't visible, of course, but the tsunami was, from satellites that just happened to be passing overhead at the right time.

Nobody had ever before seen a tsunami in the open ocean, and if you'd asked only a few years ago, you'd almost certainly have been told it was impossible. That's because, in deep water, a tsunami is nothing but a low, fast-moving swell. It only becomes dangerous when it hits shallow water and humps up, like breaking surf. But one of the satellites carried a laser altimeter, which easily spotted the deadly waves sloshing around the Indian Ocean.

Laser altimetry is an extremely precise technology capable of mapping minor variations in sea-surface height with remarkable precision.⁴ The satellite saw the tsunami as a fifty-centimeter crest followed by a forty-centimeter trough, with a wavelength of 430 kilometers, explaining why you can't possibly see it from a boat! It also revealed that rather than being a single big wave, the tsunami was an initial big one followed by hours of choppy sloshing.⁵

Another satellite managed to photograph the waves hitting shore. Again, purely by coincidence, it was passing

² Even the great San Francisco quake of 1906 probably wasn't much bigger than about 8.0. See the U.S. Geological Survey's website, <http://quake.wr.usgs.gov/info/1906/index.html>.

³ Park and others cited in this article discussed their findings at the 2005 spring meeting of the American Geophysical Union (held, ironically, in New Orleans, a few months before it suffered its own disaster). Some remarks are from press conferences and personal interviews. Others are from formal presentations for which abstracts are available at www.aga.org.

⁴ See Richard A. Lovett, "The Wired Ocean: Doing Oceanography Without Getting All Wet," *Analog*, October 2005.

⁵ News reports showed the same thing, as the coastlines were hammered by wave after wave.

over the shoreline of India and Sri Lanka about four hours after the earthquake, when the wave action was at its highest. Because the satellite had nine cameras lined up along its flight path—ahead, below, and behind—it could combine shots of each location into sequences that produced crude movies. These showed that the waves struck shore at thirty-eight miles per hour, with a frequency of about 4.8 per hour (about one every 12.5 minutes).

More importantly, the images showed precisely how the waves interacted with the coastline. Details are still being figured out, but one likely lesson is that waves slam with devastating force into broad, wall-like objects, while diverting around narrow ones with much less impact. At a small scale, this is obvious: a wave that will knock down a house won't affect a telephone pole. (One implication is that in tsunami zones, buildings should be put on stilts, perhaps with breakaway walls on the bottom floor.) As the satellite images are processed, we'll probably also learn useful things about the effects of headlands, harbors, and islands.

The same effect also works on a larger scale, where it spells the difference between what happened to India and Sri Lanka, compared to the island of Diego Garcia.

Topographically, the coasts of India and Sri Lanka were the equivalent of a wall that took the full brunt of the wave's force. Diego Garcia by contrast, rises from the ocean bottom like a tall, narrow pole. In Sri Lanka, the tsunami generated waves up to ten meters high; in Diego Garcia, the maximum height was about 2.5 meters. Basically, the tsunami ignored the island and went around it.

Listening for the Wave

Diego Garcia is only a tiny speck of

land, but its location near the middle of the Indian Ocean, south of India and Sri Lanka, makes it strategically valuable as a listening post for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), which is charged with monitoring for illegal bomb tests.⁶ It turns out that instruments designed to detect nuclear bombs can also detect lots of other things—including tsunamis.⁷

Two of these instruments are infrasound detectors and hydrophones. Infrasound is extremely low-frequency sound: not the bass thump of a big audio speaker, but lower yet, where frequencies are measured not in cycles per second, but seconds (or longer) per cycle. These super-low sound waves carry extremely well, refracting through the upper atmosphere to tracking stations where they are detected by microphone-like pressure sensors so sensitive that they could sense the air-pressure difference between the top and bottom of a sheet of paper.

Hydrophones are simply underwater microphones. Like infrasound detectors, they are laid out in arrays that can identify the direction from which the sound is coming; if a signal is received by multiple arrays, it's possible to triangulate on its source.

The Diego Garcia hydrophones are moored in deep water, at a depth of 1,200 meters. That puts them in what is known as the *T-zone*, a layer bounded above and below by discontinuities at which the water changes density. These boundary layers reflect low-frequency sound, channeling it for long distances in a waveguide effect similar to that by which light propagates through fiber-optic cables. Whales use the *T-zone* for long-distance communication.

The infrasound detectors and hydrophones both detected the earth-

⁶ It's also a military base.

⁷ See Richard A. Lovett, "Forensic Seismology, The Big Science of Minor Shakeups," *Analog*, April 2004.

quake. The infrasound sensors probably heard the sounding-board effect of seawater being bounced up and down, while the hydrophones heard the earthquake more directly, as seismic waves found their way into the T-zone.⁸

Infrasound is somewhat blurry, due to the fact that there are multiple paths the waves can take through the upper atmosphere. Hydroacoustic images are sharper. In addition to being heard in Diego Garcia, they were heard by receivers near Crozet Island (in the southern Indian Ocean) and Cape Leeuwin, Australia. This allowed triangulation on the source of the signal and gave enough detail that, if the receivers had all been linked to a central computer, it would have been possible to track the earthquake as it occurred.

It is widely believed that when faults slip, they do so simultaneously at all points. Actually, earthquakes originate at their epicenters and “unzip” their faults at finite speed.

In the case of the Boxing Day quake, Catherine de Groot-Hedlin, of Scripps Institution of Oceanography, reported that the rupture progressed northward, moving quickly for 600 kilometers, then slowing for another 550. “Slow,” of course, is a relative term. Initially, the fault unzipped at a speed of 2.4 km/sec (about 5,400 mph); by the end, it was “only” going 1.5 km/sec (about 3,500 mph).⁹

This change in speed was borne out by seismic observations and suggested that in some important way, the Boxing Day quake went through two phases. But what this means appears to be anybody’s guess. Perhaps we’ll eventually discover that it was, effectively, two mega-quakes rolled into one. Perhaps multiple phases are a common feature of mega-quakes. With only one well-

studied magnitude-9 available, it’s difficult to generalize.

For that matter, the speed change may not even have occurred. A study reported at an October 2005 meeting of the Geological Society of America combined data from 700 seismological stations in Japan in an effort to map the quake’s progress with previously impossible levels of precision. It got a very nice map of the manner in which the fault unzipped: and totally failed to find any appreciable slowdown.

Infrasound and hydroacoustics are interesting, but not worth much as earthquake warning systems because they’re limited by the speed of sound in air and water. Because seismic waves travel much more quickly through rock, seismometers will always beat them to the punch. What infrasound and hydroacoustics can do, however, is detect *tsunamis* in progress.

In the case of infrasound, the sensors heard the deeply subsonic noise of big waves sweeping around the Bay of Bengal. By then, of course, tide gauges were already registering the signal and newscasters were sending frantic broadcasts, so infrasound still can’t provide a useful warning. But hydrophones are different. Positioned between the approaching tsunami and the shore, they can recognize a tsunami passing overhead, even in open water, where you’d expect it to be impossible.

What the Diego Garcia hydrophones spotted were minute changes in the pressure of the 1,200 meters of overlying water as the tsunami rolled overhead. It was a surprising finding, because hydrophones designed to look for nuclear blasts aren’t tuned for the super-low-frequency oscillations of tsunamis (which, as we noted before, are on the order of 4.8 oscillations per hour). But

⁸ It is possible that the infrasound may also have been created by vibration of nearby landmasses.

⁹ The March 28 earthquake progressed at a steady speed of about 2.5 km/sec, but only ruptured 340 km of the fault.

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each crest of the tsunami, like a photon, is actually a wave "packet" containing a wide range of frequencies. This allowed the hydrophones to catch what, to them, were extremely low-frequency pressure changes—on the order of half a minute per cycle.

"In the tsunami community, we call that high-frequency," says Emile Okal, a geology professor from Northwestern University who was one of many scientists thrilled by the finding. Now that we realize that these arrays can spot tsunamis, he adds, upgrading them to look for even lower tsunami-wave frequencies should be easy.

Diego Garcia has two sets of hydrophone arrays. One was on the wrong side of the island, but the other was moored about 100 km offshore, more or less in the direction from which the wave arrived. Had it been programmed to sound an alert, it would have been able to do so about five minutes before the first wave hit the island. And while five minutes' notice might not sound like much, it's a lot if the meaning is "run for your life."

Currently, there are only eleven of these extremely low-frequency sensor arrays in the world, and none are programmed to detect tsunamis. Instead the data go to CTBTO headquarters in Vienna, where computers identify it as not-an-atom-blast and dismiss it as noise. But that too is an easy fix, and there's no reason the agency's computers can't be programmed to sound an alert for tsunamis as well as for nuclear tests. Perhaps someday, hydrophones might lie offshore from all vulnerable shores, waiting to sound automated alarms.

Saturated Models

Unfortunately, nobody managed to give a tsunami warning to Thailand, India, Sri Lanka, and other countries in the path of the devastation. In large part, that was because there was no warning system because prior to December 26, nobody thought the Indian Ocean was

vulnerable to large tsunamis. But it was also because seismologists, to their chagrin, discovered that it took far too long to realize just how big the earthquake had been.

The quake began at 12:59 A.M., Greenwich time. Eight minutes later, seismic stations in Australia picked it up and triggered a local alarm. Shortly after that, the Pacific Tsunami Warning Center, in Hawaii, calculated the magnitude at 8.0 and (correctly) concluded that the location precluded a tsunami threat in the Pacific. It took another hour for seismologists to revise their magnitude estimate upward to 8.5, and several more hours before a team at Harvard re-estimated it as 8.9. A month later, the Harvard team upped its estimate to 9.0, and four months after that, geophysicists raised their estimates yet again, into the range of 9.2 to 9.3.

Thanks to the logarithmic nature of the magnitude scale, the differences between 8.0, 8.5, 8.9, and 9.2 are huge—and by the time the estimate had been increased from 8.5 to 8.9, it was far too late.

This does not mean seismologists were negligent. Rather, they discovered that much of what they thought they knew wasn't right.

To understand the difficulty, it's necessary to look more closely at how earthquake magnitudes are calculated. It is frequently said that magnitude measures energy. This is true, but what it really measures is "moment," which expresses how big a chunk of the Earth's crust shifted, and by how much. (It also takes into account the strength of the rock.) A magnitude 5.0 earthquake, for example, will move a chunk of land the size of New York's Central Park by a fraction of a meter. A magnitude 8.0 would shift a fifty-kilometer by 100-kilometer block by about five meters. The Boxing Day quake did the equivalent of moving the state of California by about ten meters.

One way to measure that is with sur-

veying teams and a site visit. That, of course, takes a while and isn't feasible in the quake's immediate aftermath.

Seismology works by correlating seismic waves to moment. Fortunately for humanity, the Earth doesn't see a lot of enormous earthquakes. Unfortunately for seismologists, this means their models for big earthquakes are based on extrapolation, rather than real data. The first test of these extrapolations was the Boxing Day quake, and what it proved was that they didn't work. "Earthquakes," Okal says wryly, "do not read textbooks in seismology."

One problem is that nobody realized that big earthquakes could last as long as the Boxing Day quake did or affect such large segments of their faults. The 1994 Northridge quake in Southern California, magnitude 6.9, lasted a mere eight seconds. The 2002 Denali quake, magnitude 7.9, shook the ground for two minutes and covered 200 miles. The Boxing Day quake lasted ten minutes and unzipped 700 miles of its fault.

The best comparison might be between tapping the surface of a swimming pool with your fingertip and sloshing the water back and forth with a 2 x 4. In one case, you'll create a lot of little, rapidly oscillating waves. In the other, you'll also get big, lower-frequency ones—and the bulk of the energy will be in them.

That was the problem seismologists faced on Boxing Day. Because it lasted ten minutes, the December 26 temblor put out seismic waves with vibrational frequencies as low as six cycles per second. But the computer models didn't believe such things existed, and didn't look for them—with the result that the

models were found to "saturate" for large earthquakes, making it difficult to distinguish big ones from colossal ones. And even if the models had known what to look for, it's still going to take several tens of minutes to wait through enough of these extremely long cycles to get an accurate estimate of how strong they are. By then, the tsunami has covered hundreds of miles.

So how can you get a decent magnitude estimate without having to wait for the seismometers? Jeff Freymueller of the Geophysical Institute at the University of Alaska thinks the answer lies in GPS.

Hand-held GPS devices of the type used by hikers and boaters employ a network of satellites to pin down location to within a meter. Surface-mounted units can do orders of magnitude better, quickly enough that if the data is uplinked to the Internet, you can watch an earthquake as it occurs.

At the Spring 2005 meeting of the American Geophysical Union, Freymueller proved this is possible by using data from GPS units on landmasses within the earthquake zone, even if the GPS stations were many miles from the fault.¹⁰ If enough such units had been mounted throughout Indonesia, he said, it would have been possible to map out land displacements accurately enough to obtain a decent estimate of the earthquake's magnitude within minutes of its onset. Freymueller therefore advocates installing GPS units 100 to 200 kilometers apart near all of the Earth's major faults.¹¹

Big earthquakes, though, don't always generate tsunamis. It appears, for example, that shallow earthquakes are more

¹⁰ Earthquakes shift entire blocks of land and transmit that force around the globe. So you don't have to be right next to the fault to get useful GPS data, so long as you know how far from the fault your GPS units actually lie.

¹¹ Three hundred such units already exist in Southern California, installed in the aftermath of the 1994 Northridge Earthquake. Not only can they precisely measure displacements caused by earthquakes, but they reveal the gradual creep of rocks on each side of faults, as they build up the strains that might lead to future temblors.

likely to produce them than are deep ones, because shallow quakes produce greater up-and-down motion: and it is this, rather than side-to-side motion, which appears to be the main culprit. On Boxing Day, for example, the offshore seabed rose, while the near-shore seabed dropped, producing a catastrophic slosh. On March 28, only a relatively small tsunami was produced (small enough that nobody was killed). Partly, that may have been because it was a deeper earthquake, but more importantly, it appears that much of the motion occurred beneath a chain of offshore islands. "Instead of displacing water," Okal says, "it displaced islands. And every time you have an island, this is that many cubic meters of water that are not displaced."

The length and orientation of the fault are also important. Big undersea quakes are like guns, aiming energy in specific directions, says De Groot-Hedlin. The Boxing Day quake sent big waves east and west. To the extent that the March 28 one generated a tsunami, it beamed most of its energy to the southwest, where it dissipated in the open ocean.

The Earthquake that Wasn't . . . and One Yet to Come

Indonesia was unfortunate enough to experience the two largest earthquakes in forty-plus years. But there was also a monster that didn't occur.

To understand, we must begin with a primer on the type of earthquakes that rocked the Indonesian shoreline. Called subduction quakes, they are the result of

plate tectonics, which causes crustal plates to bash into each other in long, slow collisions—one of which is happening offshore from Indonesia. The site of the collision is marked by a trench, where the dense seabed rocks are forced downward, preparatory to dipping beneath the lighter rocks of the Indonesian archipelago.

Between quakes, pressure builds along the boundary, causing the top plate (the land) to bow upward.¹² Then the quake occurs, and the land not only springs forward, but drops. Conversely, the seabed, which has been bowing downward, springs the opposite direction. It's like stepping on one end of a springy ruler to hold it in place, while pushing on the other. The "earthquake" occurs when you lift your foot.

In the big picture of plate tectonics, all sections of a plate are trying to move in the same direction.¹³ But slippage isn't always uniform along the rupture zone. In part, that's why big temblors generate aftershocks, as various portions of the rupture zone settle into new equilibrium. On Boxing Day alone, there were 142 aftershocks of magnitude 5.0 or larger.

Then, a month later (on January 27), forty-eight such shocks occurred in rapid-fire succession, midway along the Boxing Day rupture zone. Meredith Nettles of Harvard University has dubbed these the Nicobar Island cluster because they occurred near an island of that name.

Nothing like them had ever been seen before. They look like aftershocks from

¹² One of the uses of GPS is to measure these bulges as markers of accumulating strain. But old-fashioned methods also work. In Indonesia, it had long been known that the shallow near-shore waters (which are part of the island's plate, not the seabed's) were rising. This was evident from the fact that coral reefs had been steadily pushed above sea level, killing the coral. By determining the date at which each stratum of coral died, it was possible to chart the rate of uplift. Ironically, in early December 2004, less than three weeks before Boxing Day, a group of geophysicists unveiled a brochure they had been preparing for distribution in Indonesia, explaining what this meant and outlining the earthquake risk.

¹³ In Indonesia, the Indian Ocean's plate is moving northward.

a temblor of magnitude 8.0 or larger, but there was no main temblor. Also, all of the Nicobar shocks were confined to a 25-kilometer circle.

Briefly, seismologists thought they might be precursors to a large volcanic eruption, but that didn't happen, either. Nettles' belief is that the cluster represents a segment of the top plate releasing strain from the non-uniform motion of the Boxing Day event—and somehow doing so without ever unleashing a big quake. To seismologists, this non-event was extremely exciting; to nearby residents, of course, it was blissfully *unexciting*.

Unfortunately, other parts of Indonesia may not be so fortunate.

Indonesia's offshore fault zone appears to have three segments: north, central, and south. The northern segment was the one that produced the Boxing Day quake (and the Nicobar Island cluster). Portions of it had ruptured in 1847, 1881, and 1941, producing events of approximately magnitude 8.0.

The other two segments both ruptured during the Nineteenth Century: the middle one in 1861 (magnitude somewhere between 8.3 and 8.5) and the southern in 1833 (magnitude 8.8-9.2).

The March 28 quake ruptured the middle segment along almost exactly the same boundaries as the 1861 event. To date, the southern segment has been quiescent, but worried scientists are scrambling to deploy instruments, because this segment lies offshore from some of Indonesia's most densely populated areas, including Jakarta.

The issue is whether the three segments move separately, or are more like dominoes, with movement in one shifting strain to the next in line. Hints to the answer can be found in maps of the Indian Ocean seabed. These show parallel ridges running north/south, in the direction of the plate's movement, more or less at the boundaries of the three segments.

The ridges represent places where lava oozed up along cracks in the seabed. The question, says Oxford University geophysicist David Robinson, is what that means. One possibility is that the ridges reflect weaknesses that divide the seabed into mini-platelets that move more or less independently. The other is that the ridges are sticky spots that increase the friction of the seabed plate as it slides into the subduction zone. If so, they might temporarily block a rupture in one zone from proceeding to the next. But if the two sides of the ridge are still firmly connected, slippage on one side has greatly increased strain on the other, making it likely that it will soon follow suit. There's only one way to find out which theory is correct, and that's by dumping a lot of money into understanding Indonesia's plate tectonics.

If nothing else, the Boxing Day quake proved that nature can still take us by surprise. "One casualty, if I may use that word, is our sense of large-scale plate tectonics," says Okal. "We thought we understood subduction zones based on the age of the plate and the speed of convergence. But Sumatra sends us back to the drawing board. Very few people were willing to bet that this region could entertain a major thrust, and it did. Perhaps all of these regions are capable of violating the canons of our previous understanding."

As long as such uncertainties persist, the long-run future will probably involve total global monitoring. Already, scientists can access a great many seismometer readings, online. As instruments become ever less expensive and data transmission capabilities become ever greater, it's easy to envision a world in which seismometers, GPS sensors, hydrophones, and infrasound detectors are all wired into an interconnected earthquake-alert system. And while today's satellites are too few to monitor tsunamis except by the luck of being in the right place at the right time, it's easy to imagine a future in which far more so-

phisticated satellites monitor the entire globe from geostationary orbit.

Automated Shutdowns

So far, we've focused mostly on how to warn for tsunamis. But earthquakes also knock down buildings and kill people directly, even if they're miles from the ocean. Is there any way to provide advance warnings of this?

Surprisingly, the answer is "yes." In fact, such warning systems already exist: not in the U.S., but in Taiwan, Japan, and Mexico.

The trick is to remember that however quickly seismic waves travel, electronics are faster. That means that if you install enough seismic stations, there's a reasonable chance that at least one will lie close to the epicenter—providing time, if you act quickly, to tell people what's headed their way.

Taiwan's warning system takes advantage of the fact that most of that nation's earthquakes occur in the southern part of the island, whereas most of the people live in the north. Since earthquake shock waves travel at about 100 miles per minute, a big temblor in the south will start triggering seismic stations there as much as a minute before it hits the north. Similarly, Mexico City gets about seventy seconds' notice when quakes occur on the Pacific coast.

It's even possible to develop a system that gives warning of earthquakes going on practically beneath you, though for a system like that to be useful, it has to be ultra-rapid. To do this, Richard Allen, a geophysics professor at the University of Wisconsin, has developed a computer program called *ElarMS*, which takes ad-

vantage of the fact that earthquakes produce two types of shock waves, called P-waves and S-waves. P-waves are pressure waves that vibrate in the direction in which they are traveling. They travel quickly, but carry less energy than the S-waves (or shear waves), which vibrate sideways.¹⁴

Allen's brainstorm was to use the P-waves to predict the strength of the approaching S-waves. In a 2002 study published in *Science*, he demonstrated that this could be done within one second of the arrival of the first P-wave. Obviously, such a program won't give a good estimate of magnitude, especially for megaquakes such as the Boxing Day temblor. But it should do a decent job of sorting out damaging earthquakes from minor tremors.

Such a warning system requires a great many seismometers, because its first hint of the earthquake's location comes from knowing which seismometer is hit first. As additional instruments begin to register the temblor, it's possible to triangulate, but if they're too widely scattered, it's already too late.¹⁵

Once an earthquake is sensed, the next step is to generate what the U.S. Geological Survey calls a "ShakeMap," which shows the degree to which surrounding areas are likely to be affected. Allen estimates that ShakeMaps could be created (and updated) in about four seconds.¹⁶

What can be done with less than a minute's warning? Well, that's plenty of time for residents to get out of dangerously constructed buildings. Hospitals can lock down wheels on gurneys and beds. Schools might have time to evacu-

¹⁴ For years, seismologists have used the time lag between the arrival of P-waves and S-waves to determine the distance from a seismometer to an earthquake.

¹⁵ One of the few places on the globe with enough stations to make such a system work is Southern California, where a \$20 million federal grant was used to create a 155-station network called TriNet.

¹⁶ Obviously, you also need to know the region's geology, to predict how the shaking will affect various areas. In places like California, this is well known, but geological mapping of all of the world's earthquake zones is another good project for the future.

ate classrooms. In Taiwan, bullet trains automatically apply the brakes when a warning is issued, and emergency crews are dispatched to places where they are most likely to be needed. Additional options, Allen says, would include automated shutdowns of industrial processes, aborting airplane landings, and closing bridge and freeway entrances. Even a ten-second warning might give people time to take cover, or to move away from dangerous machinery or chemicals. For a doctor engaged in delicate surgery, even five seconds' notice might be enough to stave off disaster.

The future may bring buildings designed to make use of such warnings via "active" earthquake protection devices that are turned on by the alarm. Such devices, already in use in Japan, shake the building in a manner that offsets the swaying imparted by the earthquake. One system employs a giant piston mounted horizontally on the top floor. When an earthquake hits, the piston begins to pump in counterpoint to the seismic vibrations, neutralizing the building's sway.

Normally, such devices are linked to motion sensors in the building itself, but that raises the prospect of a false alarm setting off the piston, damaging the building even though there is no earthquake. An advance warning system could be used to confirm that a vibration is real, and not simply the result of a janitor banging a cart into one of the building's internal sensors.¹⁷

Some people are concerned, though, that however useful earthquake warnings might be for automatic shutdowns, they might produce widespread panic.

Not so, said James Goltz, of (California's) Governor's Office of Emergency Services in a 2003 press conference. Social science research has found that in-

stead of panicking in the face of warnings, people tend to suffer from the illusion that nothing is actually amiss. "The sun is still shining," Goltz said. "The birds are still singing. There's no indication that strong ground motions are hurtling toward them."

More troublesome is the fact that many people will be leery of automated warnings and will want the data to be evaluated by a human decision-maker before a warning is issued. "Given the very short time frame," Goltz said, "that's not a good idea." ■

About the Author: Richard A. Lovett lives in Oregon, where he has the distinction of being science fiction's only Red Lizard. What exactly these ruddy reptiles are, he won't say, other than that they dash to the top of a 1,000-foot hill called the "Goose" every Thursday evening. A hint to the group's purpose may lie in the fact that Richard has coauthored two running books with former marathon record-holder Alberto Salazar. Between sprints, he writes for such publications as *New Scientist*, *Psychology Today*, *Running Times*, and *National Geographic News*, and tries to write at least a bit of fiction every week.

¹⁷ I am indebted for this information to Andrew Smyth, a civil engineering professor at Columbia University, who described it in December 2003, on a tour of San Francisco's earthquake-prevention efforts, at a meeting of the American Geophysical Union.

Takes Two to Tangle

Ben Bova

Research, by the nature of the beast,
tends to lead to surprises. . . .

One Sam Gunn is bad enough. But now there are at least two of them, maybe more, and it's all my fault.

Well, mostly my fault. Sam had something to do with it, of course. More than a little, as you might suspect if you know anything about Sam.

And, if you know anything about Sam, you know that of course there was a woman involved. A beautiful, statuesque, golden-haired Bishop of the New Lunar Church, no less.

I didn't know anything about Sam except the usual stuff that the general public knew: Sam Gunn was a freewheeling space entrepreneur, a little stubby loud-mouthed redheaded guy who always found himself battling the big boys of huge interplanetary corporations and labyrinthine government bureaucracies. Sam was widely known as a womanizer, a wise ass, a stubby Tasmanian Devil with a mind as sharp as a laser beam and a heart as big as a spiral galaxy.

He had disappeared a couple of years earlier out on some wild-ass trek to the Kuiper Belt. Everybody thought he had died out in that frozen darkness beyond Pluto. There was rejoicing in the paneled chambers of corporate and government power, tears shed among Sam's legion of friends.

And then after his long absence he showed up again, spinning a wild tale about having fallen into a black hole. He was heading back to Earth, coming in from the cold, claiming that friendly aliens on the other side of the black hole had showed him how to get back to our spacetime, back to home. Sam's enemies nodded knowingly: *of course* the aliens would want to get rid of him, they said to each other.

And they sent just about every lawyer on Earth after Sam. He owed megabucks to dozens of creditors, including some pretty shady characters. He was so deeply in debt that there was no place on Earth he could land his spacecraft

without having umpteen dozen eager lawyers slam him with liens and lawsuits.

Which is why Sam landed not on Earth, but on the Moon. At Selene, which was now an independent nation and apparently the only human community in the solar system that didn't have Sam at the head of its "most wanted" list.

He came straight to the underground halls of Selene University. To my office!

Imagine my surprise when Sam Gunn showed up at my doorway, all one hundred sixty-some centimeters of him.

And asked me to invent a matter transmitter for him.

"A matter transmitter?" I must have sputtered, I was so shocked. "But that's nonsense. It's kiddie fantasy. It's nothing but—"

"It's physics," Sam said. "And you're a physicist. Right?"

He had me there.

I am Daniel C. Townes IV, PhD. I am a particle physicist. I was on the short list last year for the Nobel Prize in physics. But that was before I met Sam Gunn.

Sam had popped into my office unannounced, sneaking past the department secretary during her lunch break. (Which, I must confess, often takes a couple of hours.) He just waltzed through my open doorway, walked up to my desk, stuck out his hand and introduced himself. Then he told me he needed a matter transmitter. Right away.

I sagged back in my desk chair while Sam perched himself on the only bare corner of my desk, grinning like a gap-toothed Jack-O-Lantern. His face was round, with a snub nose and a sprinkling of freckles. His eyes were light, twinkling.

"Physics is one thing," I said, trying to regain my dignity. "A matter transmitter is something else."

"Come on," Sam said, wheedling, "you guys have transmitted photons, haven't you? You yourself just published a paper about transmitting atomic parti-

cles from one end of your lab to the other."

He had read the literature. That impressed me.

You have to understand that I was comparatively young at the time. Young enough to think that I might be the youngest person ever to receive the physics Nobel. I had to be careful, though. More than one young genius had been cut down by the knives that whirl through academia's hallowed halls in the dark of night.

I think Sam had roosted on my desk because that made him taller than I was, as long as I remained sitting in my swivel chair. I have to confess, though, that there wasn't anyplace else he could have sat. My office was littered with reports, journals, books, even popular magazines. The visitor's chair was piled high with memos that the secretary had printed out from the department's unending file of meaningless trivia. There might be no paper on the Moon, but we sure do pile up the monofilament plastic sheets that we use in its place.

"So how about it, Dan-o?" Sam asked. "Can you make me a matter transmitter? It's worth a considerable fortune and I'll cut you in on it, fifty-fifty."

"What makes you think—"

"You're the expert on entanglement, aren't you?"

I was impressed even more. Entanglement is not a subject your average businessman either knows or cares about.

Curiosity is a funny thing. It not only kills cats, it makes physicists forget Newton's Third Law, the one about action and reaction.

I heard myself ask him, "Did you really survive going through a black hole?"

Grinning even wider, Sam nodded. "Yep. Twice."

"What's it like? What did you experience? How did it feel?"

Sam shrugged. "Nothing to it, really. I didn't see or feel anything all that unusual."

"That's impossible."

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Sam just sat there on the corner of my desk, grinning knowingly.

"Unless," I mused, "the laws of physics change under the intense gravitational field . . ."

"Or I'm telling you a big, fat lie," Sam said.

"A lie?" That stunned me. "You wouldn't—"

"Look," Sam said, bending closer toward me, "I need a matter transmitter. You whip one up for me and I'll give you all the data in my ship's computer."

I could feel my eyes go wide. "Your ship? The one that went through the black hole?"

"Twice," said Sam.

Thus began my partnership with Sam Gunn.

Ingrid MacTavish was something else. A missionary from the New Morality back Earthside, she had come to Selene to be installed as a Bishop in the New Lunar Church. She was nearly two meters tall, with bright golden hair that *glowed* and cascaded down past her shoulders, and eyes the color of green tourmaline. A Junoesque goddess. A Valkyrie in a virginal white pants suit that fit her snugly enough to send my blood pressure soaring.

I'll never forget my first encounter with her. She stormed into my office and, without preamble, demanded, "Is it true?"

It's hard to keep a secret in a community as small and intense as Selene. Rumors fly along those underground corridors faster than kids on jetblades. Sam wanted me to keep my work on the matter transmitter absolutely, utterly, cosmically top-secret. But the word leaked out, of course, after only a couple of weeks. I was surprised that nobody blabbed about it before then.

That's what brought Bishop MacTavish into my office, all one hundred and eighty-two centimeters of her.

"Is it true?" she repeated.

She was practically radiating right-

eous wrath, those green eyes blazing at me.

I swallowed as I got politely to my feet from my desk chair. I'm accustomed to being the tallest person in any crowd. I'm just a tad over two meters; I'd been a fairly successful basketball player back at CalTech, but here on the Moon even Sam could jump so high in the light gravity that my height wasn't all that much of an advantage.

Bishop MacTavish was not accustomed to looking up at anyone, I saw.

"Is what true?" I asked mildly. A soft answer turneth away wrath, I reasoned.

I think it was my height that softened her attitude. "That you're working on a device to transmit people through space instantaneously," she replied, her voice lower, gentler.

"No, that is not true," I replied. Honestly.

She sank down into the chair in front of my desk, which I had cleaned off since Sam's first visit. There were hardly more than three or four slim reports resting on it.

Bishop MacTavish looked startled for a moment; then she slipped the reports out from beneath her curvaceous rump and let them fall to the floor in the languid low gravity of the Moon.

"Thank God," she murmured. "That's one blasphemy we won't have to deal with."

"Blasphemy?" I asked, my curiosity piqued.

She blinked those gorgeous eyes at me. "A matter transmitter, if it could be made successfully, could also be used as a matter duplicator, couldn't it?"

It took me a moment to understand what she was saying; I was rather hypnotized by her eyes.

"Couldn't it?" she repeated.

"Duplicator? Yes, I suppose it might be feasible . . ."

"And every time you use it you'd be murdering a human being."

"What?" That truly stunned me. "What are you talking about?"

"When someone goes into your transporter his body is broken down into individual atoms, isn't it? The pattern is sent to the receiver, where the body is reconstituted out of other atoms. The original person has been destroyed. Just because a copy comes out of the receiver—"

"No, no, no!" I interrupted. "That's fantasy from the kiddie shows. Entanglement doesn't work that way. Nothing gets destroyed."

"It doesn't?"

I shook my head. "It's rather complicated, but essentially the process matches the pattern of the thing to be transported and reproduces that pattern at the other end of the transmission. The original is not destroyed; it isn't harmed in any way."

She cocked a suspicious brow at me.

"It takes a lot of energy, though," I went on. "I doubt that it will ever be practical."

"But such a machine would be creating living human beings, wouldn't it? Only God can create people. A matter duplicator would be an outright blasphemy, clearly."

"Maybe so," I muttered. But then I came back to my senses. "Uh . . . although, that is, well, I thought that people create people. You know . . . uh, sexually."

"Of course." She smiled and lowered her lashes self-consciously. "That's doing God's work."

"It is?"

She nodded, then took a deep breath. I nearly started hyperventilating.

"But if you're not working on a matter transmitter," she said, breaking into a happy smile as she started to get up from the chair, "then there's no cause for alarm."

The trouble with being a scientist is that it tends to make you honest. Oh, sure, there've been cheats and outright frauds in science. But the field has a way of winnowing them out, sooner or later. Honesty is the bedrock of scientific re-

search. Besides, I didn't want her to leave my office.

So I confessed, "I am working on a matter transmitter, I'm afraid."

She looked shocked. "But you said you weren't."

"I'm not working on a device to transport people. That would be too dangerous. My device is intended merely to transmit documents and other lightweight, non-organic materials."

She thumped back into the chair. "And you're doing this for Sam Gunn?"

"Yes, that's true."

She took an even deeper breath. "That little devil. Blasphemy means nothing to him."

"But the transmitter won't be used for people."

"You think not?" she said sharply. "Once Sam Gunn has a matter transmitter in his hands he'll use it for whatever evil purposes he wants."

"But the risks—"

"Risks? Do you think for one microsecond that Sam Gunn cares about risks? To his body or his soul?"

"I . . . suppose not," I replied weakly.

"This has got to be stopped," she muttered.

I finally came to my senses. "Why? Who wants to stop this work? Who are you, anyway?"

"Oh!" She looked suddenly embarrassed. "I never introduced myself, did I?"

I tried to smile at her. "Other than the fact that you're worried about blasphemy and you're the most incredibly beautiful woman I've ever seen, I know nothing at all about you."

Which wasn't entirely true. I knew that she believed the act of procreation was doing God's work.

"I am Bishop Ingrid MacTavish," she said, extending her hand across my desk, "of the New Lunar Church."

"You must be a newcomer to Selene," I said as I took her hand in mine. Her grip was firm, warm. "I'd have noticed you before this."

"I arrived yesterday," she said. Neither one of us had released our hands. "Actually, I'm an ethicist."

"Ethicist?"

"Yes," she said. "There are certain ethical inconsistencies between accepted moral practice on Earth and here in Selene."

That puzzled me, but only for a moment. "Oh, you mean nanotechnology."

"Which is banned on Earth."

"And common practice here on the Moon. We couldn't survive without nanomachines."

"That's one of the reasons why I decided to set up my ministry here on the Moon."

Interesting, I thought. "And the other reason?"

She hesitated, then answered, "I've been hired temporarily by a consortium of law firms to find Sam Gunn and serve him with papers for a large number of major lawsuits."

At that moment, with impeccable timing, Sam bounced into my office.

"Hey, Dan-o, I've been thinking—"

Ingrid jumped to her feet, stumbling clumsily because she was unaccustomed to the light lunar gravity.

Sam rushed over to help her and she lurched right into his arms. With her height, and Sam's lack of same, Sam's face got buried in Ingrid's bosom momentarily while I stood behind my desk, too stunned to do anything more than gape at the sight.

Sam jerked away from her, his face flame red. The little guy was actually embarrassed! Ingrid's face was red, too, with anger. She swung a haymaker at Sam. He ducked, she staggered off-balance. I came around my desk like a shot and grabbed Ingrid by her shoulders, steadying her.

Sam backed away from us, stuttering, "I didn't mean to . . . that is, it was an accident . . . I was only trying . . ." Then he seemed to see Ingrid for the first time, *really* see her in all her statuesque beauty. His eyes turned into saucers.

"Who . . . who are you?" Sam asked, his voice hollow with awe.

Ingrid pulled free of me, but I noticed that she placed one hand lightly on my desktop. "I'm your worst nightmare," she hissed.

"No nightmare," Sam said. "A dream."

She wormed a hand into the hip pocket of her snug-fitting trousers and pulled out a wafer-thin data chip. "Sam Gunn, I hereby serve you legal notification of—"

Sam immediately clasped his hands behind his back. "You're not serving me with anything, lady. You've got no jurisdiction here in Selene. You have to go through the international court and even then you can only serve me if I'm on Earth, in a nation that's got an extradition treaty with the North American Alliance. Which Selene hasn't."

Ingrid smiled thinly at him. "Well, you know your law, I must admit."

Sam made a little bow, his hands still locked behind his back. "How'd you get in here, anyway? Selene doesn't allow Earthside lawyers to come here. Legal issues with Earth are handled electronically."

"Which is why you're hiding here in Selene," Ingrid replied.

With a Huck Finn grin, Sam acknowledged, "Until I can recoup my fortune and deal with all those malicious lawsuits."

"Malicious?" Ingrid laughed. "You owe Masterson Aerospace seven hundred million for the spacecraft you leased. Forty-three million—and counting—to Rockledge Industries for expenses on the orbital hotel that you haven't paid for in more than two years. Nine million—"

"Okay, okay," Sam conceded. "But how can I settle with them when they've got all my assets frozen?"

"That's your problem," said Ingrid.

"Why don't we discuss it over dinner?" Sam suggested, his grin turning sly.

"Dinner? With you? Don't be ridiculous."

"Scared?"

She hesitated, then glanced at me. I caught her meaning. She didn't want to be alone with Sam.

"Sam," I said, "we have a lot to talk about. I've got a working model just about finished, but to build a real machine I'm going to need some major funding and—"

Sam's no dummy. He caught on immediately. "Okay, okay. You come to dinner, too."

Turning back toward Ingrid, he asked, "Is that all right with you? Now you'll have a chaperone."

Ingrid smiled brightly. "That's perfectly fine with me, Mr. Gunn."

The Earthview is the oldest and, to my mind, still the best restaurant in Selene. On Earth, the higher you are in a building the more prestigious and expensive; that's why penthouses cost more than basement apartments—on Earth. On the Moon, though, the surface is dangerous: big temperature swings between sunlight and shadow, ionizing radiation constantly sleeting in from the Sun and stars, micrometeoroids peppering the ground and sandpapering everything exposed to them.

So in Selene, prestige and cost increase as you go down, away from the surface. The Earthview took in four full levels: its main entrance was on the third level below the Grand Plaza, and an actual human maitre d' guided you to tables set along the winding descending rampway that led all the way down to the seventh level.

The place got its name from the oversized screens that studded the walls showing camera views of the surface with the Earth hanging big and blue and majestic in the dark lunar sky. I never got tired of gazing at Earth and its ever-changing pattern of dazzling white clouds shifting across those glittering blue oceans.

Sam had reserved the best table in the place, down at the very lowest level.

While we waited for Ingrid to arrive, Sam and I had a drink: lunar "rocket fuel" with carbonated water for me and plain South Pole water for Sam. He pumped me for everything I knew about her.

"I didn't realize she's working for lawyers. She told me she's an ethicist, and a Bishop in the New Lunar Church," I said.

"A Bishop? That's enough to give a man religion, almost," he mused.

"I never heard of the New Lunar Church before. Must be something new."

"Fundamentalist," Sam said knowingly. "Connected to the New Morality back Earthside."

"She did say something about blasphemy."

"Blasphemy?"

"In connection with the matter transmitter."

"Blasphemy," Sam muttered.

I took a sip of my drink. "Sam, there's something I've got to ask you."

"Ask away," he said blithely.

"Why do you want a matter transmitter? I mean, what in the world do you plan to do with it? You can't use it for people—"

"Why not?"

"It's too dangerous. We don't know enough about entanglement to risk people. Not even volunteers."

"Maybe there are some pets in Selene we can test it with," Sam muttered.

"Pets?" I shuddered at the idea of sending a dog or cat into the device I was building. Even a goldfish. Maybe the bio labs have some mice, I thought.

"Relax," Sam said, smiling easily. "I don't want to send people through space. Or pets. Just certain kinds of paperwork."

"Paperwork?"

"Legal tender. Money." He screwed up his face in a thoughtful frown for a moment. Then, "Legal documents too, I guess."

"Why?"

ANALOG

"Tax haven." Sam smiled his happiest, sunniest smile. "I'm going to turn Selene into a tax haven for all those poor souls down on Earth who're trying to hide their assets from their money-grabbing governments."

"A tax shelter? Selene?"

"Sure. Earthside governments won't let you carry your money off-planet. They won't even allow you to bring letters of credit or any other papers that can be transformed into money."

"It's all done electronically," I murmured, reaching for my drink again.

"Right. And taxed electronically. Every goddamned financial transaction between Earth and the Moon is monitored by those snake-eyed tax collectors and their computers."

"That's Earthside law, Sam."

"Yeah; sure. But if a person could send money or its equivalent from Earth to the Moon through a matter transmitter, privately, instantaneously, with nobody else knowing about it . . ." He leaned back in his chair and gave me that sly smile of his.

"Money would stream into Selene," I realized. "Money that people want to hide from their tax collectors."

"Selene could get very wealthy, very fast."

"The governments on Earth would be furious," I said.

"Right again. But what can they do about it? They tried to muscle Selene once with Peacekeeper troops and got their backsides whipped."

"But . . ."

"Besides, the richer Selene gets, the more Earthside politicians we can buy."

"Bribery?"

"Lubrication," Sam corrected. "Money is the oil that smoothes the machinery of government."

"Bribery," I said, firmly.

Sam shrugged.

A tax haven. A shelter for the fortunes that wealthy Earthsiders wanted to hide from their governments. It was wrong. Insidious. Definitely evil. But it could

work!

And it could even result in more funding being available for Selene University. More funding for my research.

If I could make a matter transmitter.

"So how's the zapper coming along?" Sam asked, reaching for his South Pole water.

For the next fifteen minutes or so I nattered on about entanglement and the bench model I was almost ready to test. Sam appeared to listen closely; he asked questions that showed he understood most of what I was telling him.

Then all of a sudden he looked past my shoulder and his eyes went wide as pie plates. I turned in my chair. Ingrid MacTavish was coming down the ramp-way toward our table.

Even in the modest pure white floor-length outfit she was wearing she looked spectacular. Radiant. Heads turned as she followed the maitre d' past the other tables. And not just men's heads, either. Ingrid looked like a glowing golden-haired empress proceeding regally toward her throne. She was even followed by a quartet of acolytes, all of them women, all of them dressed in unadorned white suits. Compared to Ingrid they looked like four dumpy troglodytes.

Sam bounded to his feet and held her chair for her, making the normally impassive maitre d' frown at him. The acolytes seated themselves at the next table.

"Bishop MacTavish," Sam murmured as she sat down.

"Mr. Gunn," she replied. Then, with a nod toward me, "Dr. Townes."

I swallowed hard and tried to say something but no words came out. All I could do was smile and hope I didn't look like a complete idiot.

Sam was at his charming best all through dinner. Not a word about his legal troubles. Or about the matter transmitter. He regaled us both with improbable tales of his past misadventures.

Despite myself, I felt intrigued. "Tell

us about the black hole, Sam," I begged. "What really happened to you?"

Ingrid seemed equally curious. "Did you actually meet truly intelligent alien creatures?"

"Very intelligent aliens," Sam said.

"What were they like? Did they have souls? Were they able to—"

"We didn't talk religion," Sam replied. "They were little guys. Smaller than me. Smart, though. High level of technology. I want to go back and learn how they operate that black hole."

"Do you?" Ingrid asked. "Wouldn't that be dangerous?"

Sam gave her his what-the-hell grin. "Lady, danger's my middle name."

"You're not worried about the danger to your soul?"

Sam blinked at her. "My soul's in decent shape. It's my finances that I'm worried about."

Ingrid scoffed, "What does it profit a man if he gains the whole world . . ."

"I don't want the whole world," Sam replied. "I just want my assets unfrozen and all you lawyers off my back."

"What would you give in return for that?"

That stopped Sam. But only for a moment. "You could make all these lawsuits go away?"

"I think a settlement could be arranged," she said.

"A settlement?"

"A settlement."

"Forgive me my debts," Sam mused, "as I forgive my debtors."

"Even the Devil can quote scripture," Ingrid retorted.

They were talking as if I wasn't there. I felt like a spectator at a tennis match; my eyes shifted back and forth from one to the other.

"Mr. Gunn, the New Morality—"

"Sam," he said. "Call me Sam."

Ingrid smiled. "Very well. Sam."

"May I call you Ingrid?" he asked her.

Her smile widened slightly. "Bishop MacTavish, Sam."

"No," Sam replied, not taken aback at

all. "I'll call you Aphrodite: the goddess of beauty."

I saw anger flare in her green eyes, but only for the flash of a second. She controlled it immediately.

"That's the name of a pagan goddess."

"It's the only name I can think of that fits you," Sam said, looking totally sincere.

And then I heard myself blab, "Galileo said, 'Names and attributes must be accommodated to the essence of things, and not the essence to the names, for things come first and names afterward.'"

They both stared at me. "What?"

"Well, I mean . . . that is . . ." I was back in the conversation, but floundering like a particle in Brownian motion.

"Galileo was a notorious heretic," Ingrid said.

"The Church apologized for that, er . . . misunderstanding," I said. Then I added, "Three hundred and fifty-nine years afterward."

"What's Galileo got to do with anything?" Sam demanded.

"Well, he said names should be given based on the observable attributes of the thing being named." Turning to Ingrid, I said, "I think naming you Aphrodite is completely appropriate."

She looked thoughtfully at me. Then, her face totally serious, "You mean that as a compliment, Dr. Townes. And I accept it as such. Thank you."

"Dan," I said. "Please call me Dan."

She nodded, then turned back to Sam. "But you, Sam, you're trying to seduce me, aren't you?"

"Me?" The innocence on Sam's face was about as obvious as a flying elephant. And as phony.

"You," Ingrid said sternly.

Gesturing toward the next table, Sam asked, "Is that why you brought the Four Horsewomen of the Apocalypse? For protection?"

"I don't need protection from you, Sam. I can take care of myself."

Sam h'mmfed. "I bet you're still a virgin."

"That's none of your business."

He shrugged. "Now what was this about forgiving me my debts?"

It took her a moment to get her mind back on business. At last she folded her hands on the tabletop and said slowly, carefully, "The New Morality is willing to intervene on your behalf in the various lawsuits against you."

"The New Morality, huh?" If this surprised Sam he certainly didn't show it. "They own a lot of stock in Masterson, and Rockledge too, don't they?"

"That's neither here nor there."

"And what do I have to do to get the New Morality to save my ass?"

Her eyes flared again at Sam's crudity. I figured he had chosen his words precisely to rattle her.

"You will give up this effort of yours to create a matter transmitter."

"Wait a minute!" I yelped. "That's *my* work you're talking about!"

"It is blasphemous presumption," said Bishop MacTavish. "You are both placing your souls in grave danger."

"Bullsnorts!" Sam snapped. "The New Morality doesn't want a matter transmitter because it would loosen their control over people."

"This is a matter of religion, Sam," Ingrid said. "The state of your soul—"

"Stow it, Aphrodite. This is a matter of politics. Power. The New Morality isn't worried about my soul, but they're scared that a matter transmitter might let people do things they don't want them to do."

Ingrid turned to me. She actually reached across the table and took my hands in hers. "Daniel, you understand, don't you? You can see that I'm trying to save your soul."

I was thinking more about my body. And hers.

"Ingrid," I said, my voice nothing more than a husky whisper, "we're talking about my work. My life."

"No," she replied softly. "We're talking about your soul."

Up to that moment I hadn't even con-

sidered that I might possess a soul. But gazing into those green eyes, with her hands in mine, I started thinking about how wonderful it would be to please her, to make her smile at me, to be with her for all eternity.

"Hey! Break it up!" Sam said sharply. "I'm supposed to be the seducer here."

At that, all four of the women at the next table got to their feet. I saw that they were all pretty hefty; they looked like professional athletes.

"Bishop MacTavish," one of them said in a sanctimonious whisper, "it's time to leave."

Ingrid looked up at her quartet of bodyguards as if breaking free of a trance. She pulled her hands away from me and nodded. "Yes. I must go."

And she left me there, staring after her.

I thought I knew as much about entanglement as any person living. More, in fact. But all I knew was about subatomic particles and quantum physics. Not about people. And I got myself entangled with Bishop Ingrid MacTavish so completely that I couldn't even see straight half the time.

We had dinners together. She visited my lab several times and we had lunch with my grad student assistants. She and I took long walks up in the Main Plaza, strolling along the bricked lanes that curved through the greenery so lovingly tended up there beneath the massive concrete dome of the Plaza. I kissed her and she kissed me back. I fell in love.

But she didn't.

"I can't let myself love you, Daniel," she told me one evening, as we sat on a park bench near the curving shell of the auditorium. We had attended a symphonic concert: all Tchaikovsky, lushly romantic music.

"Why not?" I asked. "I love you, Ingrid. I truly do."

"We live in different worlds," she said.

"You're here on the Moon now. We're in the same world."

"No, it's your work. Your soul."

She meant the matter transmitter, of course. I spread my hands in a halfhearted gesture and said, "My soul isn't in any danger. The damned experiment isn't working. Not at all."

She looked hopefully at me. "It *is* damned! It's that devil Sam Gunn. He's leading you down the road to perdition."

"Sam? He's no devil. An imp, maybe."

"He's evil, Daniel. And this matter transmitter he wants you to make for him—it's the Devil's work."

"Come on, Ingrid. That's what they said about the telescope, for god's sake."

"Yes, for God's sake," she murmured.

"Do you really think what I'm doing is evil?"

"Why do you think your experiment won't work? God won't allow you to succeed."

"But—"

"And if you do succeed, if you should somehow manage to make the device work the way Sam Gunn wants it to, it will only be because the Devil has helped you."

"You mean it'll be witchcraft?" My voice must have gone up two octaves.

Ingrid nodded, her lips pressed into a tight line. "Don't you see, Daniel? I'm struggling to save your very soul."

And there it was. She was attracted to me, I knew she was. But my work stood in the way. And her medieval outlook on life.

"Ingrid, I can't give up my work. It's my career. My life."

She bowed her head. Her voice so low I could barely hear her, she said, "I know, Daniel. I know. I can't even ask you to give it up. I do love you, dearest. I love you so much that I can't ask you to make this sacrifice. I won't ruin your life. I should do everything in my power to get you away from this devilish task you've set yourself. But I can't bring myself to do it. I can't hurt you that way. Even if it means both our souls."

She loved me! She admitted that she

loved me! But nothing would come of it as long as I worked on Sam's matter transmitter.

I told Sam about it the following morning. Actually, he ferreted the information out of me.

Sam was already in my lab when I came in that morning. He was always bouncing into the lab, urging me to make the damned benchtop model work so we could go ahead and build a full-scale transmitter.

"Why isn't it working yet?" he would ask, about twenty thousand times a day.

"Sam, if I knew why it isn't working I'd know how to make it work," I would always reply.

And he would buzz around the lab like a redheaded bumblebee, getting in everybody's way. My three technicians—graduate student slave labor—were getting so edgy about Sam's presence that they had threatened to go to the dean and complain about their working conditions.

This particular morning, after that park bench confession from Ingrid the evening before, I had to drag myself to the lab. Sam, as I said, was already there.

He peered up at me. "What bulldozer ran over you?"

I blinked at him.

"You look as if you haven't slept in a week."

"I haven't," I muttered, heading for the coffee urn the techs had perking away on one of the lab benches.

"The good Bishop MacTavish?" Sam asked, trailing after me.

"Yep."

"She still trying to save your soul?"

I whirled around, my anger flaring. "Sam, I love her and she loves me. Stay out of it."

He put up his hands in mock surrender. "Hey, I'm just an innocent bystander. But take it from me, pal, what she really wants from you is to give up on the transmitter."

"You want her yourself, don't you? That's why—"

"Me?" Sam seemed genuinely astounded by the idea. "Me and that religious fanatic? You've gotta be kidding!"

"You're not attracted to her?"

"Well, she's gorgeous, true enough. But there are too many other women in the world for me to worry about a psalm-singing bishop who's working for lawyers that're trying to skin me alive." He took a breath. "Besides," he added, "she's too tall for me."

"She loves me. She told me so."

Sam hoisted himself up onto the lab bench beside the coffee urn and let his stubby legs swing freely. "Let me give you a piece of priceless wisdom, pal. Hard earned on the field of battle."

I grabbed the cleanest-looking mug and poured some steaming coffee into it. Sam watched me, his expression somewhere between knowing and caring.

"What wisdom might that be?" I asked.

"It's about love. Guys fall in love because they want to get laid. Women fall in love because they want something: it might be security, it might be their own sense of self-worth, it might even be because they pity the guy who's coming on to them. But to women, sex is a means to an end, not an end in itself."

I felt like throwing the coffee in his face. "That's the most cynical crap I've ever heard, Sam."

"But it's true. Believe me, pal. I know. I've got the scars to prove it."

"Bullshit," I snapped, heading for the non-working model on the bench across the lab. I noticed that one of the grad students had hung a set of prayer beads from the ceiling light over the equipment. A cruel joke, I thought.

"Okay," Sam said brightly, hopping down from his perch. "Prove that I'm wrong."

"Prove it? How?"

"Make the dingus work. Then see if she really loves you, or if she's just trying to make you give up on the experiment."

Talk about challenges! I stared at the clutter of equipment on the lab bench. Wires and heavy insulated cables snaked all over the place, hung in festoons from the ceiling (along with the prayer beads) and coiled across the floor. They say a neat, orderly laboratory is a sign that no creative work's being done. Well, my lab was obviously a beehive of intense creativity.

Except that the damned experiment refused to work.

Make the transmitter work, and then see if Ingrid still says she loves me. What was that old Special Forces' motto? Who dares, wins. Yeah. But I thought there was a damned good chance of my darning and losing.

Yet I had to do it. To prove to Ingrid that the transmitter wouldn't destroy my soul, if for no other reason.

So I fiddled around with the power feeds and the connections between the plasma chamber and the thin mesh grid that served as the platform for the beam's focus. The same damned flimsy sheet of monofilament that I wanted to transmit to the other side of the lab sat on the grid just as it had for the past two weeks, like a permanent symbol of frustration.

Entanglement. All the equipment had to do was to match the quantum states of the monofilament's atoms and transmit that information to the receiver, across the lab. That's a lot of information to juggle, but I had six oversized quantum computers lined up against the lab's wall, more than enough qubits to handle the job. In theory.

I checked the computers; they were connected in parallel, humming nicely, awaiting the command to go to work.

Everything checked, just as it had for the past two weeks. I went to the master control, on the other side of the bench. I noticed my three grad students edging toward the door. They weren't worried about the equipment exploding; they knew from experience that I was the one who blew up when the sys-

tem failed to work.

Sam was standing by the door, arms folded across his chest, a curious expression on his face: kind of crafty, devilous.

"Ready," I called out. Then, "Stand clear."

The latter call was strictly routine. The nearest human body to the equipment was several meters away, by the door. Except for me, and I made sure I was on the other side of the apparatus from the focus grid, shielded by the bulk of the plasma chamber.

As if I needed protection. I pushed the keypad that activated the equipment. It buzzed loudly. The plasma chamber glowed for a moment, then went dark. The sheet of monofilament stayed right there on the focus grid, just as it had since the first time I tried to make the godforsaken junk pile perform.

I took a deep breath and started counting to one hundred.

Then I heard a scuffle behind me. Turning, I saw Sam had a hammerlock on one of my grad students; he was dragging the kid toward me.

"He had this in his pocket," Sam said, tossing me a slim plastic oblong from his free hand. The grad student was grimacing; Sam had his arm screwed up pretty tight behind his back.

"It's a remote of some kind," I muttered, turning the device over in my hand.

"He clicked it on just before you pressed the start button," Sam said.

I turned to the student, W. W. Wilson. He was the beefy kind; I was surprised Sam could hold an armlock on him. "Woody," I asked, dumbfounded, "what the hell is this?"

Woody just glared at me, his chunky face red with either anger or pain. Maybe some of both. He was a biology graduate who had volunteered to work in my lab for a little extra spending money.

Sam hiked the Woody's arm up a little

higher and said, "You either tell us or I'll personally pump you so full of babble juice your brain'll shrink to the size of a walnut."

"Go ahead and torture me!" Woody cried. "I'm prepared to suffer for my faith!"

"Let him go, Sam," I said. "We're not the Gestapo."

Sam shot me a disapproving frown, but released Woody's arm. I clicked the cover off the remote and studied its interior. It seemed simple enough. It looked somewhat like an old-fashioned cell phone. But it had no keypad, no display screen.

I looked up at Woody. "What frequency band does this work on?"

Woody just scowled at me, as he rubbed his arm.

"I can find out for myself easily enough." I started for the array of test equipment stored in the lab's lockers.

"Microwave," Woody muttered. "Just enough power to scramble the recognition circuitry."

"Sabotage," Sam growled. "A goddam saboteur planted here by the New Lunar Church."

My heart sank.

"Not that bunch of pansies," Woody snarled. "I was sent here by the New Morality, straight from Earthside headquarters in Atlanta."

Sam jabbed a finger at him. "You must be doing real well in your bio classes."

"I lead the class discussions in Intelligent Design," Woody said, with some pride. "I can tie those Darwinians into pretzel knots."

"And you screwed up Dan-o's experiment."

"I'll do more than that!" Woody suddenly leaped past Sam and me and grabbed the cover of the plasma chamber. He ripped it off and threw it to the floor.

"I'll wreck this Devil's tool once and for all!" he yelled, reaching for the focal grid. The grid was oversized, much bigger than I needed it to be; I had scav-

enged it from a colleague's experiment with a PET full-body scanner. Yet Woody was wrenching it out of its hold-down screws; the screech of the screws ripping out of the bench top was enough to freeze my blood.

I was paralyzed with shock, but Sam sprang onto the kid's back like a monkey jumping onto a racing horse, knocking him on top of the lab bench. They wrestled around on the half bent focal grid, arms and legs thrashing, grunting and swearing. Woody was much bigger, of course; he got atop Sam and started punching him with both fists.

It seemed like hours, but it was really only a few seconds. I finally came out of my surprised funk and grasped Woody by the shoulders and pulled him off Sam. I threw him to the floor; he hit with a heavy thud.

Sam sat up, a little groggily, on the focus grid. His nose was leaking a thin stream of blood, otherwise he looked okay.

"Sam, are you all right?"

He shook his head slightly. "Nothing rattles. That kid can't punch worth shit. Hey, *look out!*"

I turned. Woody was on his feet. He slammed a fist onto the control panel keyboard. "Die, spawn of Satan!" he screamed.

The power thrummed, the plasma chamber pulsed, the overhead lights dimmed and then went dark. The emergency back-up lights came on. But nothing else happened. Sam still sat on the focus grid, with that damned sheet of monofilament beneath his butt.

I swung around on Woody and socked him in the jaw as hard as I could. His head snapped back, his knees folded, and he collapsed to the floor, unconscious.

Sam whistled appreciatively. "That's a helluva punch you've got there, Dan-o." He jumped down from the bench and bent over Woody. "He's out like a light."

And from across the lab, where the receiving grid was, Sam Gunn said,

"What'm I doing over here?"

I stared at Sam, clear on the other side of the lab. Then I turned back to Sam, who was still standing by the bench, right beside me.

Two of them!

I think I fainted.

When I came to, both Sams were standing over me. I was sitting on the floor next to Woody's still-unconscious body, my back propped against the lab bench.

"Are you okay?" one of the Sams asked me.

"You need a doctor?" asked the other one.

I looked from one to the other. Identical, down to the number and location of his freckles.

"It worked," I said. "The experiment. It worked!"

"Of course it worked," said Sam I.

"Once this bozo stopped sabotaging it," Sam II said, casting a frown at Woody.

My erstwhile lab assistant was groaning now, his legs shuffling back and forth. His eyes fluttered open.

Both Sams grabbed his arms and helped him up to a sitting position.

Woody looked at each of them in turn, his eyes widening with horror, his face going pasty white. He screeched like a giant fingernail scraping across a chalkboard, scrambled to his feet, and bolted for the door. My two other grad students were right behind him. They all looked terrified.

"Unclean!" Woody yelled as he tore out of the lab. "Unclean!"

Both Sams shook their heads. "He should've said Eureka."

I struggled to my feet unassisted. I felt a little woozy, my legs rubbery, but my mind was whirling madly. I did it! I proved that entanglement can be used not merely to transmit macroscopic objects but to duplicate them: a human being, no less!

Visions of the Nobel danced through my head.

But then I thought of Ingrid. What would her reaction be?

A little unsteadily, I headed for my desk and the phone. Both Sams trailed along behind me.

Time for the moment of truth.

I phoned Ingrid right then and there, and asked her to come to my lab. In the phone's smallish screen, her exquisite face looked more curious than anything else.

"To your lab?" she asked. "Right now?"

I nodded. "Big news. I want you to see it before anyone else does."

Her expression changed immediately. To dread. "I'll be there in a few moments."

I paced the lab from one end to the other while the Sams got themselves into an argument.

"First thing we do is set up the tax shelter."

"Better secure the spacecraft first. That Bishop MacTavish is going to try to seize it."

"Let her! Once the tax shelter's in operation we'll have money pouring in."

"Never let the enemy cut off your line of retreat."

"We don't need the ship anymore! We can just about print money, for god's sake."

"Print money?" Whichever Sam it was suddenly got a thoughtful, crafty look on his snub-nosed face. "Print money."

The other Sam grinned at his twin. "Duplicate financial instruments. Ought to be a pile of money there."

"Duplicate women!"

"Wow! Twins!"

"Made to order."

"Now wait a minute," I said. "The duplicator is mine, not yours."

They both turned to me, their faces identically disappointed, stunned with betrayal.

"You wouldn't refuse me the use of your contraption, would you, Dan-o?"

"After all, I'm the one who got you

started on this experiment. Without me, you'd still be doodling with theory and equations."

Before I could reply the lab door swung open and Ingrid strode in, looking like an avenging angel in a gold sweater and hip-hugging jeans. I nearly fainted again.

She said not a word, but stared at the two Sams for what seemed like an hour and a half. Both Sams grinned impishly at her and then bowed, simultaneously.

"You did it," she said to me in a near-whisper.

"It was sort of an accident," I began. "I had no intention of duplicating Sam."

Ingrid sank to the nearest stool. I thought I saw tears in her eyes.

"Oh, Daniel," she said, in a sorrowful moan. "Now all hell is going to break loose over you."

To say that all hell broke loose would be an exaggeration, but not much of one. News of my success spread throughout Selene in a microsecond, it seemed. My grad students must have shouted it out to everyone they passed in the corridors, like Paul Revere warning of the redcoats.

Ingrid looked truly heartbroken, but when the Sams told her about Woody her chin snapped up and her eyes suddenly turned fiery.

"The New Morality?" she asked. "He said he was sent here directly by the New Morality?"

"Straight from their headquarters," Sam I replied. Or was he Sam II?

"In Atlanta," the other Sam added.

"They bypassed me to plant a spy in your laboratory?" Ingrid asked.

"That's what he told us," I said.

"They never told me about it," she murmured. "They knew I'd be opposed to such a low trick."

"They didn't trust you," said a Sam.

"No, they didn't, did they?" Ingrid looked crestfallen, heartbroken. "They merely used me as a distraction while their spy did his best to ruin your exper-

iment."

"But they failed," I said. "And I succeeded."

She nodded, her expression turning even bleaker. "And what happens now, Daniel? What happens to you, my love? What happens to us?"

Before I could even begin to think of an answer, a quartet of Selene security police strode into the lab.

"By order of the council," their leader pronounced, "these premises are to be evacuated and sealed until further notice."

The Sams started to object, but the officer went on, "And Sam Gunn is hereby placed under protective custody."

"You mean I'm going to jail?" both Sams yelped.

All four policemen fixed the two Sams with beady gazes. "Which of you is Sam Gunn?" their leader asked.

"I am," said both Sams in unison.

The officer looked from one Sam to the other, obviously trying to decide what to do. Then he turned to his cohorts and commanded, "Bring 'em both in."

The following morning I was awakened by a phone message inviting me to a meeting of Selene's governing council, which would convene at eleven A.M. precisely. "Invite" is a relative term: when the governing council invites you, you show up, on time and ready to cooperate.

It wasn't a trial, exactly. More of an executive hearing. It took place in a windowless conference room up in the executive office tower that rises from the middle of the Grand Plaza to the roof of the dome. The room's walls were paneled with smart screens, much like the screens down at the Earthview restaurant, but when I entered, shortly before eleven, the walls were dead blank gray. Not a good sign, I thought.

The entire governing council of Selene was already seated at the oblong conference table, all six of them. Dou-

glas Stavenger himself sat on one of the chairs lined along the wall. He hadn't been on the council for years, but as the *de facto* leader of Selene, the man who had led battle that resulted in Selene's independence, he had obviously taken an interest in our case. He looked much younger than his calendar years: as everyone knew, Stavenger's body was filled with nanomachines.

The council chairman was a prune-faced man with thinning gray hair. Obviously he didn't take rejuvenation therapies, which led me to the conclusion that he was a religious Believer of one sort or another. He directed me to the empty chair at the foot of the table.

As I sat down I heard a raucous hullabaloo from the corridor outside. All heads turned toward the door, which burst open. Both Sams stalked in, escorted by a squad of uniformed security guards. Both Sams were yammering away like triphammers.

"What's the idea of putting me in jail?"

"Who's in charge here?"

"What's this bull droppings about protective custody?"

"I want a lawyer!"

"I want two lawyers!"

"You can't do this to me!"

One Sam Gunn jabbering nonstop is bad enough; here were two of them.

Pruneface, up at the head of the table, raised both his clawlike hands over his gray head. "Mr. Gunn!" he shouted, in a much more powerful voice than I'd have thought him capable of, "please shut up and sit down! There!" And he pointed to the two empty chairs flanking me.

"Why am I here?"

"What's going on?"

"This is an emergency meeting of the governing council," the chairman explained, in a slightly lower tone. "An informal hearing, if you will."

Both Sams trudged grudgingly to the foot of the table and sat on either side of me.

"Now then," the chairman said, from the head of the table, "Dr. Townes,

could you kindly explain how in the world you produced a duplicate of Sam Gunn?"

I blinked at him. "You want me to explain how entanglement works?"

"In layman's language, if you please."

I glanced around at the other council members. Three women, two men. In their forties or older, I guessed from their appearances. Probably at least two of them were scientists or engineers: Selene's population leans toward the technical professions.

I took a deep breath and began, "Basically, my device assesses the quantum states of the atoms in the subject and reproduces those quantum states in the atoms at the receiving end of the equipment."

"It is a matter duplicator, then?"

"It was intended to be a transmitter, but, yes sir, it has functioned as a duplicator. There are still some details that are not quite clear, but—"

The door behind the chairman slid open and Ingrid entered the conference room, wearing a gold-trimmed white uniform with a choker collar and full-length trousers.

"I'm sorry to be late," she said, her face deadly serious. "I wasn't informed of this hearing until a few minutes ago."

Everyone stood up.

"Bishop MacTavish," murmured the chairman, indicating an empty chair facing down the table.

Once we seated ourselves again, the chairman explained, "Bishop MacTavish is here as a qualified ethicist."

"And a representative of the New Lunar Church," said the councilman on the chairman's right.

The Sam on my left squawked, "What's the New Lunar Church got to do with this?"

"Excuse me, Mr. Chairman," Ingrid said, "but I'm afraid you're working under a misapprehension. I am here in my capacity as legal counsel."

"For Rockledge Industries, et al.," muttered the Sam on my right.

"No," Ingrid replied. "I am representing Dr. Townes." And she smiled so sweetly at me that my heart nearly melted.

Both Sams leaned in to me and whispered, "Watch out. This could be a trap."

Was Ingrid a Judas goat? I refused to believe it. But the possibility gnawed at me.

When the council members started asking me questions about my experiment Ingrid rose to her feet and said sternly, "This council has no legal right to question Dr. Townes, except as to how his work might affect the safety of Selene and its citizens."

"But he's duplicated a human being!" one of the councilwomen sputtered.

"Sam Gunn, no less," grumbled the councilman beside her.

"I am morally opposed to such a duplication as much as any of you," Ingrid said, still on her feet. "I regard it as little short of blasphemy. As a Believer and a Bishop of the New Lunar Church, I am appalled."

Here it comes, I thought. She'll recommend burning me at the stake.

But Ingrid went on, "Yet, as a woman who has lived in the freedom of a democratic civilization—and as an applicant for citizenship in your nation of Selene—I cannot support the imposition of limitations on Dr. Townes' research, or on the intellectual freedom of any person."

My eyebrows popped up to my scalp, almost. Both Sams looked surprised; so did most of the council members. I saw Douglas Stavenger nodding his agreement, a slight smile of satisfaction on his face.

"The New Lunar Church has no objection to this work?" the council chairman asked.

"I shudder to think that a human being would aspire to usurping God's creative powers," Ingrid said. "But after having thought on the matter and prayed on it, I have concluded that Dr.

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Townes has not actually created a human being, he has merely duplicated one."

"So the council has no moral right to object to his work?" asked the chairman.

"Not in my view, nor in the view of the New Lunar Church."

"Very well," said the chairman, a grin spreading across his face. "Now let's get down to the real reason for this hearing. Dr. Townes, you caused a power outage through three-quarters of Selene. Is the university going to pay for that?"

"Power outage?" I gasped. "I thought it was only in my own lab."

"Surely you noticed that the emergency lights were on throughout several levels for four hours after your experiment."

"That contraption of yours drained the system," grumped one of the councilmen, "knocked out two inverters, and overheated the coolant in the cryogenic transmission lines from our main solar panel farm, up on the surface."

"It did?" Now that he mentioned it, I realized that after our little fracas in my lab the corridors had been lit by the emergency lamps. Even my quarters had been, too, when I got there after the police took Sam away.

"We can't have that kind of drain on our power system," said the chairman. "I think the council will agree that you must be prohibited from running your equipment again."

"Until you can provide your own electrical power for it," said the grumpy councilman.

Ingrid hadn't sat down yet. Raising her voice over the murmurs of conversation buzzing around the table, she said, "If I may, I would like to take this opportunity to serve Mr. Gunn with the subpoenas I've been carrying."

The chairman gestured grandly. "Go right ahead."

"You can't do that!" yelled one of the Sams.

The other, just as red-faced, added, "Selene's constitution specifically

states—"

"Our constitution," said the chairman sternly, "allows specific exceptions to the extradition clause, Mr. Gunn."

Both Sams snapped their jaws shut with audible clicks.

Turning to the Sams, Ingrid asked, "Which of you is the original?"

"He is," said both Sams in unison, pointing at one another.

Ingrid frowned at them. "One of you is a copy. I have to serve these papers to the original."

"That's him," they both said.

Ingrid looked from one of them to the other. Then she turned back to the chairman. "As you can see, although no one has the right to curtail Dr. Towne's intellectual freedom, his experiment has created certain practical difficulties."

I realized that I'd created a Pandora's Box. So I compromised. Actually, I caved in. I promised the council that I'd dismantle my equipment and scrap it. I would not publish anything about my experiment. I would forget about entanglement and study other aspects of quantum physics.

Which meant I could kiss the Nobel Prize goodbye.

The council was very relieved. Ingrid, though, seemed strangely unhappy.

That evening in the cafeteria, as we nibbled at a dinner neither one of us had any appetite for, I said to her, "I thought you wanted me to scrap the duplicator."

She gazed at me with those luminous green eyes of hers. "I did, Daniel. But now I realize that I've ruined your life."

"It's not ruined, exactly."

"I'm dreadfully sorry."

I tried to put a good face on the situation. "It's a big universe, Ingrid. There are plenty of other questions for me to work on."

"But you—"

A hubbub over by the doorway distracted us. Both Sams were scurrying through the cafeteria like a pair of spaniels hunting for a bone.

"Hey! There they are!" said Sam I to Sam II. Or vice versa.

They rushed to our table and pulled up chairs. "Gotta hurry Dan-o. My ship's ready to leave."

"Leave? For where?"

The other Sam replied, "Back to that black hole in the Kuiper Belt. Wanna come with me?"

Ingrid was immediately suspicious. "How did you get the money to—"

"Rockledge!" both Sams crowed. "And Masterson Aerospace and all those other big buffoons who were suing me"

"They're financing your mission to the Kuiper Belt?"

"Yeah." The Sams' grins were ear-to-ear. It was eerie: they were *exactly* alike. "They're willing to pay mucho dinero to get rid of me."

I got their meaning. "They're hoping that this time you go away and stay away."

Nodding and laughing, one of the Sams said, "Yeah. But what they don't know is that only one of me is going."

"And the other?"

They both shrugged.

"I don't know," said one. "Maybe I'll go back into the zero-gee hotel business."

"Or build a resort at Hell Crater," said the other one.

"Or turn Selene into a tax shelter. How's the Church of Rightful Investments sound to you?" They both winked at Ingrid simultaneously.

"You've stolen my matter transmitter!" I snapped.

A Sam raised both his hands in a gesture of innocence. "Me? Steal? No way!"

Before I could let out a satisfied sigh, though, the other Sam added, "But now that we know a transmitter can work, there oughtta be some bright physicist who's willing to build me a new one."

"Sam, you can't!" Ingrid and I objected together.

They both grinned at us. "Maybe not. We'll see."

So I went out to the Kuiper Belt with one of the Sams. Much to my surprise and delight, Ingrid went with me. She really did love me, and still does. We were married over an electronic link to the Vatican, no less, just before we broke lunar orbit.

We've lived happily ever since. And I did eventually win the Nobel, thanks to what we found out in the Kuiper Belt.

And Sam . . . both Sams . . . well, that's another story. ■

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Rival of Mars

David Walton

New conditions create new opportunities and new necessities, but that doesn't mean the choice gets easier.

I didn't realize Angie was pregnant until she started to show. We lay touching and teasing in bed together, late on a Friday evening, when I noticed something different. A bulge. It was only visible because she was so thin: a gentle swelling that hadn't been there a week before. Suddenly, the idea that Angie was a mother became a startling reality.

"It's my job," she said. "You knew that."

I knew. I think we all know things we don't believe until we see them. At the time, all I could think was that *something* lived inside that bulge, growing and moving and feeding.

"Does it bother you?" she asked.

I looked away. "No, of course not."

"It's a natural process. Mothers have been doing it for millennia."

I couldn't keep my eyes off her belly. Birth control was mandatory in those days—the pleasure drug craze of our

parents' generation had resulted in so many birth defects that the government had taken control. Only one in a hundred women could make motherhood a career, and even the licensed guardians who hired them placed their orders through an agency, rarely meeting the gestational mother. The only mother I'd known before Angie had been a sagging veteran of twenty births, and I was having trouble reconciling my mental stereotype with the reality snuggled in my bed. I wanted to talk about it, but I didn't know what to say.

"How do you feel?" I hazarded.

"I feel fine."

"How long until it's born?"

"She's about sixteen weeks along, but I tend to go late, so probably not for another twenty-five. Early August."

I groped into the dark, cluttered bag of my knowledge about pregnancy. "I thought pregnancy made women not want to . . ." I looked at the bed, then

back at her.

"Sometimes," she said. "And sometimes it makes them randy as rabbits." She said it in that matter-of-fact, business-like tone she always used, but her eyes twinkled.

I reached into the bag again, and came up empty. "So . . . what happens now?"

She leaned in close. "Right now? We make love."

Angie was twenty-six when I met her, with three births under her belt and a figure like a holostar. She did calisthenics, yoga, weight toning, kung fu, dance, and tai chi. She was the fittest, funniest, fieriest woman I'd ever met.

I didn't give her career much thought. I was working as an aerospace engineer for a NASA subcontractor; we were building an Earth Return Vehicle for a manned mission to Mars. Motherhood, by contrast, seemed a cakewalk—only on the job nine months out of twelve, and plenty of free time even then. True, the actual childbirth was said to be a painful ordeal, but only for one day a year. How bad could it be? I thought it sounded like a fair price for 364 days of freedom.

That was before I met Angie.

One morning over breakfast, I said, "I hear labor's not too bad. More like pressure than real pain."

"Just pressure, sure," she said. "Kind of like a hurricane is just wind."

I laughed. "Okay, so it's painful," I said. I poured chocolate milk on my Berry Bombs. Then I noticed her breakfast. "What's that?"

"A multi-grain muffin."

"I can't believe they make you eat that stuff."

Angie rolled her eyes. "They don't make me. I plan my own diet."

"But you have to report what you eat to your clients, right?"

"It's not a normal job, darling. What I eat affects the baby. How much I exercise, what medicines I take, even the

music I listen to, it all makes a difference."

I tried to imagine my company telling its employees what to eat or how much sleep to get.

Angie took a big bite of her muffin and chewed as if she really enjoyed it. She said, "I'm on an all-natural job, so it's more restrictive. I can't even use painkillers."

"What? Not even Tylenol?"

"Nope. Nobody's ever connected Tylenol to fetal complications, but the 'nothing artificial' stamp is a big seller. Means more profit for the agency, and a better salary for me."

"What about during labor? A . . . what's it called . . ." I rubbed at the stubble on my chin, trying to remember the word.

"An epidural?"

"That's it. Can you have one of those?"

"Not on this job. All natural, all the way."

I made a face. "And that's worth the extra money?"

"It's not just the money. It's painful, but it's wonderful in a way, too. Creating new life—it's a remarkable experience."

"One of those things a guy can never understand?" I asked.

Angie just smiled.

I knew a challenge when I saw one. I'm an engineer; I don't believe in problems with no solution. I determined to conquer the ancient female mystery of childbirth with the modern tools of research and investigation. While her belly grew, I hit the info sites. I learned terms like amniocentesis, alpha-fetoprotein, episiotomy, gestational diabetes, Braxton-Hicks contractions, and postpartum stress. I knew the difference between an embryo and a fetus, between gestational age and age from conception, and what milestones to anticipate in each trimester.

I still wasn't prepared. I thought of the stages of pregnancy like the stages of a rocket launch, systematic and timed pre-

cisely. I had the timetable memorized. So I was taken aback when, a week too early, Angie grunted and placed both hands on her belly.

"Well, hello," she said.

"Are you okay?" I asked.

"Fine. The baby just moved."

"Already?"

"Definitely. This is going to be a feisty one. You'll be able to feel it, too, before long."

"I'm not sure I want to," I said.

From then on, she took to grabbing my hand several times a day and holding it to her belly. "There," she would say. "You felt that one, right?" I felt nothing but her belly, which was growing steadily larger. Finally, I told her I'd felt a movement so she'd stop trying.

"Isn't it amazing?" she asked, eyes shining.

"Amazing," I said. "Really, it's remarkable."

She didn't stop trying. If anything, she did it more—every time she felt the baby move, she'd snatch my hands and want me to feel it, too. She'd even poke and prod her belly, trying to get the baby to kick.

"Should you really do that?" I asked.

"It doesn't hurt."

"At the zoo, they always tell you not to tap on the glass. Annoys the animals."

"It's not the same thing. The baby likes external interaction."

"You can't know what the baby likes."

"Oh, and after my degrees in nursing and midwifery, Mr. Rocket Scientist is going to tell me what I know about this baby." She threw my hand back at me and tucked in her shirt with a sniff.

Two weeks later, I did feel the baby move. We were sitting on our porch swing late one evening, watching the stars. I'd pointed out Venus to Angie, and named a few constellations. She sat leaning against me with her feet curled up beside her, holding my hand against her belly.

"Is that Mars?" she asked, pointing.

"No," I said, "It's a star. A red giant named Antares. You're not the first one to make that mistake, though—the name 'Antares' means 'Rival of Mars.' It looks red because it's running out of hydrogen, and the outer layers are expanding and cooling down." I was about to explain the spectral classes of stars when the skin of her stomach *moved*. I jerked my hand away. It was so unexpected, I didn't realize at first what had happened.

"Gotcha," said Angie. "That was a big one."

I'd expected to find the movement disturbing—the idea reminded me too much of those old movies where aliens grow inside human beings and then eat their way out. But it wasn't disturbing. It was more like first contact—a communication from an unknown world. Something really was alive in there.

"I felt it," I said. "I really did feel it."

I put my hand back on the same spot, hoping to feel it again.

It wasn't that I didn't believe there was a baby before that moment, but I'm an engineer—I understand what I can see and touch. Feeling that kick moved the baby out of the realm of fantasy more than my web research ever did. I started wondering what it felt like to be curled inside such a small space, seeing nothing, hearing only Angie's voice, jouncing and rolling as Angie moved. I wondered what part of the baby had just pushed out at me. A foot? A hand? An elbow? I pressed slightly with my fingers, and it moved again.

At twenty weeks, Angie went for her tomograph. This was back when aircars were new, and I'd bought one of the first models, a Dodge Elation. I insisted on chauffeuring Angie to her appointment. The car elevated smoothly on its cushion of air, glided forward, and we headed off to the birthing agency. In the parking lot, I purposely gunned the car over a speed bump, enjoying the complete absence of any jolt.

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"Honestly," said Angie, "you're like a teenager in this thing. Let me out."

The agency resembled a doctor's office in most respects, though instead of talking to a receptionist, Angie slipped an ID card into a reader and walked to the imaging room herself. I followed, noting the high-res hologrid next to the examination bed. She lay down on the bed, crinkling the paper cover, and folded her hands over her growing abdomen. I sat on a tan swivel stool and watched her.

It occurred to me that getting pregnant wasn't like getting fat. Her body was still trim and athletic, just with a sensual curve where one hadn't been before. Besides, she glowed now. Her eyes radiated a vitality and love of life that the inconveniences of pregnancy didn't dull. If anything, I was more attracted to her. I told myself it was an evolutionary throwback—attraction to fertile females being more likely to propagate the species—but I couldn't wait for this appointment to be finished so I could get her back to my apartment. I didn't realize that by the time we left, sex would be the furthest thing from my mind.

The technician arrived, chatty and cheerful. Dousing us in a constant patter of encouraging remarks, she wrapped a fat torus around Angie's middle and fastened it with Velcro. "It uses acoustic waves, just like the old ultrasounds," she said, "but the images are taken as a continuous series of slices. That way we can composite the whole three-dimensional image onto the hologrid."

So saying, she activated the machine. A full-color 3D image leapt out of the grid and began rotating. I stared at it dumbly.

"The baby's black?" I said.

I regretted the question instantly; the technician herself was black, and what was wrong with a black baby, anyway? It was just that for the first time, it hit me that this was somebody *else's* baby. The result of the genetic coupling of two

strangers, the legal offspring of someone completely unrelated to Angie or myself. Fortunately, the technician didn't take my astonishment for racism.

"The color is artificial," she admitted. "It's dark in there, after all; we can't get true color imagery. But the computer uses genetic information to influence its color choices. There's no doubt this is an African-American child."

The technician manipulated the image, examining the fetus from every angle. She pointed out healthy indicators to Angie in a jargon I didn't understand. After checking the outside of the baby, she began to check the inside, slicing away grisly cross-sections to show bones and internal organs, including a living, beating heart. Angie was delighted. I felt a little ill.

"Hmm," the technician said.

I heard the concern in her voice and looked back at the hologram. She had zoomed in quite close; I couldn't even tell what part of the anatomy was being displayed.

"This is the spine," she said, indicating a light-colored splotch. "These are vertebrae, here and here, and right there I see a gap. It looks like the spinal cord hasn't closed."

I looked at Angie and saw her alarm. "Spinal bifida?" she asked.

"I don't know. Often with spinal bifida, there's a protrusion from the back, and there's nothing like that here. Just this gap."

"But my amnio showed normal acetylcholinesterase," said Angie.

"Maybe it's nothing. Some less serious anomaly, or just a software artifact. I'll have the specialist take a look."

The examination ended. We drove home in silence.

"What is it?" I asked later.

"A birth defect. The spinal column is supposed to close in the first month of pregnancy. If it doesn't, the damage to the spinal cord can mean significant paralysis, learning disabilities, a whole

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host of problems.”

“What will they do if she’s got it?”

“We’ll have to terminate the pregnancy.”

“What?”

“It’s the only thing to do. The client isn’t paying to have a child with a serious illness.”

“Isn’t there some treatment?”

“No. There’s a lot they can do, but they can’t cure it.” She sounded sad, resigned. “It happened to me once before, when a client couldn’t make his payments. It’s not my baby, but I get attached anyway, to the idea of it. It’s hard to let go.”

I felt unaccountably disturbed. Despite appearances, I knew the fetus wasn’t really human, not in a moral sense. It was just an organ in Angie’s body. She, or the agency, could choose to do whatever was prudent. Maybe it was the corporate approach that bothered me. I told myself it was none of my business.

We spoke little over dinner. Angie picked at her all-natural bread and ate only half of her salad. She left early and slept at her own apartment.

I drove to see her the next morning before work. The doctor called during breakfast. Angie said nothing but “yes” and “thank you,” but I could tell from her face that the news was good. She hung up the phone, sat down at the table, and took a sip of orange juice.

“Well?” I said. “What did she say?”

Angie grinned. “There’s nothing wrong. It was a false indicator; she said there’s no reason to believe the baby has any defect at all.”

I was elated. Leaving what was left of my breakfast, I kissed her, then dragged her off to the bedroom. I was late for work that morning, but I didn’t care.

The month of April was warm and wet. It seemed to rain every day. Angie switched to her maternity wardrobe, a classy collection of outfits that made room for her expanding middle. I spent more time at work preparing a demo for

our ERV prototype. I was slated to pitch our proposal to NASA in early July.

The baby’s movements became startlingly pronounced. I could see it move, like a ripple underneath Angie’s skin.

“That’s weird,” I told her. I was reminded again of aliens eating their way out of human abdomens.

Angie grinned. “Want to see it again?” She poked her belly with an index finger and a ripple slid over to the other side.

“I can’t believe how much you poke her,” I said. “Aren’t you afraid she’ll get brain damage?”

“I’ll poke you,” she said, and attacked me with her index fingers. I grabbed her hands, spun her around, and held her trapped against me. She screamed and wriggled, and we fell backwards onto the couch.

Twenty minutes later, when we lay spent and panting together, she said, “Ever wonder what it was like to have a family?”

I could tell she meant the question seriously. I pushed up on my elbows so I could look her in the face.

“You mean the classic marriage and kids, like before the Family Freedom Act?”

“I guess. It doesn’t sound romantic when you put it like that.”

“It wasn’t romantic. It was restrictive. Angie, I want to be with you for as long as we’re happy together, but no one’s forcing us. That way, you know I’m here because I like you, not because a law compels me.”

“You really believe all that?” she said.

That made me angry. I climbed off of her and sat up on the couch. “Of course I do. Don’t you?”

“The Family Freedom Act was a reaction to a social crisis,” said Angie. “Millions of women addicted to pleasure drugs, thousands of birth defects, rampant child abuse. It doesn’t mean it’s the best way to run a society.”

“But it’s a good way. Why have half of your population tied up with childbirth when they could be working? It’s more

efficient to specialize. Besides, with only individuals licensed as guardians, there are no disagreements about where children belong. Do you want to go back to the days where the government forced people to stay in relationships that didn't work anymore? When women were expected to stay at home and cook and clean and raise children instead of pursuing their own dreams? It's taken us generations to break away from that."

Angie stood up. Her face was flushed.

"And what about me?" she asked. "Are you going to leave when I get fat and ugly?"

I stood up, astonished. "No," I said. "Look, don't take it personally." I put my hand on her shoulder, but she shrugged it off.

"What if your company transfers you somewhere else? Or you just get tired of Philadelphia?"

"Then I could go. Or stay. Or you could come with me. The point is, it's up to us."

She let me touch her then, and I pulled her into a hug. "I'm sorry," she said. "I know you want to be with me. It's just that sometimes . . ."

"Don't worry about it," I said.

I saw little of Angie in the ensuing weeks. My time and my mind were consumed by propulsion systems, aerobrakes, retrorockets, and orbital maneuvering mechanics. We were building a prototype to accompany a contract proposal. If NASA awarded the contract to our company, it would mean years of work building the real thing.

One evening, when I arrived home after 9:00, Angie met me at the door.

"I'm starved. Let's go to Texas Grill."

"A steak house? Now?"

"Did I stutter?"

I held my hands up, palms outward. "Texas Grill it is."

We climbed into the aircar. I started the fans spinning, then depressed the elevator. The elevator clicked, the fans whined, then . . . nothing. We remained

solidly on the ground.

Angie rolled her eyes. "Fancy piece of junk," she said. "What's the matter, run out of air?"

"I don't understand it," I said, toggling the elevator.

"New technologies never seem to live up to the advertisements."

"Maybe there's a faulty compressor."

"Come on, get out," she said. "We'll take my car."

We jounced our way to the Grill in her ground Cavalier. That late on a Tuesday, the place was deserted, and we were seated right away.

"Maybe the fan computer needs calibrating," I said.

"Will you be quiet about your car? I want to enjoy my meal."

I ordered the baby back ribs. Angie ordered a sixteen-ounce medium-rare Delmonico steak with extra mushrooms.

"What happened to the diet?" I asked.

"This is the diet. If I crave it, the baby needs it. Today she wants protein."

"Bloody carnivore."

She glared at me. "I'm a bloody Amazon superwoman, is what I am."

To my horror, she started to cry. I hadn't caught any warning signs. I had no idea what was wrong.

"What is it?" I asked.

She waved a hand in the air. "Nothing. It's just . . ."

I held her hand across the table. "Just what?"

"I hardly see you anymore. I know, you've got work; it's important; I don't want to keep you from it. It's just . . . I'm alone so much, and . . . I know it's probably just hormones, but . . ." She wiped her eyes with a napkin.

"I'm sorry," I said, not knowing what else to say.

"Don't be sorry." She straightened and folded her napkin. "I'll be all right now."

"Would it help if I took a day off? We could spend a long weekend together; go down to Inner Harbor or Annapolis and take a sailboat out for a day."

"You're such an engineer," she said.

"What does that mean?"

"It means stop trying to fix me. I'm just feeling sad, that's all. It'll pass."

"Can't I do anything to help?"

"Just listen."

I listened. She didn't say anything. We sat in silence for several minutes. I hated seeing her like this; she usually seemed so in control.

"If your job moved somewhere else in the country," she said finally, "would you follow it?"

I thought about the question, and what might be behind it. "I'd probably want to," I said. Then: "Would you come with me?"

She held my gaze through red-rimmed eyes. "I'd probably want to," she echoed, "but I don't think I could give up motherhood. At least not until I have one of my own."

"One of your own? You mean, get a guardian license? Be the mother *and* the guardian?"

"Why not? It's something I've always wanted to do."

"Wouldn't there be some kind of conflict of interest?"

"Don't be ridiculous. Women have done it for thousands of years."

"Well, I guess. But if we moved somewhere else, you could find another agency."

"Yes, with a hundred applicants for each opening. It wasn't easy to land the job I have. If I left this agency, I might never have another chance."

I didn't answer for a moment. Then I said, "Those are the issues. Either we'd give each other up, or one of us would sacrifice career options. But Angie, it's all hypothetical. Let's wait until it happens before we lose any sleep."

She gave me a watery smile. "There is someplace I'd like to go. For a long weekend."

I was happy to change the subject. "Where to?" I said.

"My 10-year high school class reunion, July 12th, in Buffalo."

I groaned.

"Come on. For me."

"It'll be a nightmare. A room full of strangers trying to pretend they're years younger than they really are."

"They're not strangers to me."

"You'll be eight months pregnant then. Don't you have to stay near Philly?"

"It's three weeks before my due date. None of my babies have come early, and it's not like there are no doctors in Buffalo. Besides, I'm a certified midwife. If we get caught in a freak July snowstorm, I can deliver the baby myself."

"You'll turn a few heads," I said, nodding at her belly.

"That's why I want to go. It'll be a scream."

Her tone was light now, but I could sense the tears just under the surface.

"We'll do it," I said. "It's, what, a six-hour drive?"

"About that. But I'd like to stop on the way and see my sister Lisa. She lives in a cabin up in the Poconos. I haven't seen her in over a year."

"She lives alone?"

"With a man, now, though I haven't met him. I think his name is Harold."

"I'll be flying to California two weeks before that," I said. "That's when my demo is scheduled. But I should be home well before the 12th."

We talked about the trip for the rest of the meal. Angie didn't cry again. When we finished, I had to ask for a take-home box. Angie had cleaned her plate.

At the end of June, I flew out to the Jet Propulsion Lab in Pasadena, California to demo our ERV prototype to NASA execs. It was my first time at JPL, and I loved the environment: scientists and engineers at the top of their fields, every one of them thrilled at the prospect of sending a man to Mars. It would take years to accomplish, but everyone at JPL believed it could and would be done. I felt at home.

The proposal process hit delays, however, and took longer than expected. Finally, on July 11th, the Exploration Program Office accepted our proposal for

consideration, and I prepared to return home. I called Angie, and we arranged for her to meet me at the Philadelphia airport. We would drive straight from there to her sister's, and then on to Buffalo.

I had just turned in my badge to the JPL security desk when one of the mission directors intercepted me. He was a giant in the community: a former astronaut and a leader in every significant space mission since Zeus.

"I'm glad I caught you," he said. "That was an impressive demo."

I thanked him, waiting for his real purpose.

"Listen," he said, steering me toward some green plush chairs in the lobby, "we're not going to give the contract to your team."

I gaped at him. I hadn't seen any of the demos from competing contractors, but I felt we had a strong proposal. How could a winning bid have been selected in only a few hours, without following the review board process?

"It's a political decision," he said. "Your company already won a big piece of the launch contract, and they want to spread the funds around, to promote future competition. It'll go through the review board as usual, but at the end of the day, the contract will go to another team."

"Why are you telling me this?" I said.

He smiled. "I don't like losing talent. I need engineers who understand the whole mission, not just isolated components. I think you do. In short, I want to hire you. You'd be on my staff, one of my firefighters, with input into the whole system. What do you think?"

I felt blindsided. That my ERV design would be scrapped for political reasons made me furious, but the chance to be a serious player on the team that sent a man to Mars! How could I pass that up? But did I really want to be mired in an environment so governed by political concerns? And what about Angie?

"Can I get back to you?" I said.

"Yes, think about it," he said. He pressed a business card into my hand. "Call me. Soon."

I took the card. He stood. "As I said, an impressive demo."

"Thanks," I said.

I walked out of the building, feeling dizzy. A senior technical position on a space mission! It would mean a higher salary, better benefits, but most importantly, the chance to be part of the action. To know every system, to be consulted on critical decisions, and finally to watch from the ground as the technology I designed made history.

The problem was Angie. She'd as much as told me she wouldn't be willing to leave Philadelphia. Having a baby of her own meant that much to her. If I wanted this job, it might very well mean leaving her behind. Could I do that? I thought about nothing else the whole flight home, but when we touched down in Philly, I was no closer to a decision.

Angie met me in the baggage claim area. She seemed twice the size she'd been when I'd left.

"How's the baby?" I asked.

"Enormous. It's hard to sleep anymore from the kicks and contractions."

"Contractions?"

"Not the real thing, just preliminary. It's my body getting warmed up."

She seemed so happy. Despite her size, she seemed to float down the airport hallways, and she couldn't stop smiling. I fingered the business card in my pocket. I ought to tell her about the job offer right away, but I didn't want to spoil her mood. Maybe I could wait until the long car trip; she'd have a lot of questions, and it would be easier to talk once we were on the road.

"So how did it go?" she asked.

"Fine," I said. "The people there are great. It was an exciting time to visit."

She took my arm as we walked toward the parking lot. "You'll win the contract," she said. "I know you will."

We reached the lot, and there, neatly parked, was my Elation.

"You brought my car?"

"I thought you might prefer it. Since you're going to be doing all the driving."

I hugged her. "Thank you," I said. I'd been dreading six hours in her Cavalier.

We climbed in, paid the machine at the gate, and set off on I-76 toward the Pennsylvania Turnpike.

"So you're not sleeping?" I asked.

"How well do you think you'd sleep with something the size of a bowling ball pressing down on your bladder?"

I laughed. "You've only got another three weeks, though, right?"

"Until my due date. But I've always gone late. I think all this discomfort is just my body's way of preparing my mind for labor. I get so tired of having this baby inside me that I actually look forward to it."

To me, a relaxing road trip means soft jazz on the stereo, attractive scenery, and quiet, lazy hours. To Angie, it means constant conversation. She kept up a constant patter all the way up the Northeast Extension to I-81 in Scranton, then for another half-hour along I-84 East. I barely heard her. I kept thinking about the job offer, kept trying to find an appropriate point in the conversation to bring it up. Maybe it was better to wait until I'd made a final decision; that way, if I decided to stay, she'd never have to know at all. But no, Angie and I had always communicated well; that's why our relationship worked. I had to tell her. But when we turned off I-84 at the Milford exit and headed north, I still hadn't said a thing.

The road wound its way through woods and into higher elevation. The air grew cool and fresh. At a row of ten mailboxes, we turned left onto a bumpy dirt road. The aircar hovered smoothly, unaffected by the terrain.

"I take back everything I ever said about your car," said Angie. "It's a pregnant woman's dream. In my car, this road would kill me."

"Which cabin is hers?"

"It should be the last one on this road. About a quarter-mile down."

We caught glimpses of a lake through the trees, its surface shimmering silver in the sunlight. I could see why people chose to live up here. It was beautiful. We'd just passed the ninth cabin when Angie said, "Ouch!"

"What is it?"

"I'm having a contraction."

I stole a glance at her face. "Everything okay?"

"Yes, no problem; it happens a lot now. Wow. Feel how tight my belly is."

I reached over and felt the tense muscles.

"Does it hurt?" I asked.

"A little. It's mostly . . . watch the road!"

I looked up just in time to see it: a bridge floored with metal grating instead of concrete, the kind called "singing" bridges for the sound tires make on their surface. My car didn't have any tires. It was too late to stop. I floored the accelerator, hoping for enough momentum to reach the other side. We almost made it.

It was a small bridge, no more than a twenty-foot span across a mossy brook, but its metal grid sliced through the car's air cushion like a cheese grater, and gravity took control. We struck the bridge surface nose-first, the force of the collision severing the supports on the far side. The bridge angled sharply, and we fell with it, scraping sparks down its length until we jolted into the stream.

I couldn't hear. In some faraway place, I thought Angie was screaming, but I couldn't think why. A sign, why hadn't there been a sign to warn about the bridge? In most places, the advent of aircars had forced these bridges to be replaced, but apparently not many aircars made it up here. Maybe there had been a sign, and I hadn't noticed. It occurred to me that we were going to be late for the class reunion.

My last thought before I blacked out was that my feet were getting wet.

DAVID WALTON

The car door wrenched open, and a beefy man with red hair shouted at me from a long distance. He took a handful of stream water and threw it in my face.

"Are you hurt?" he shouted, and his voice sounded much louder this time. "Can you walk?"

I stumbled out of the car into the knee-high stream. "Angie—where's Angie?"

"In the house," said the man. "Come on; I'm Harold." He helped me climb the bank. I made it into the living room, a rustic affair that smelled of pine and fresh fish. Angie lay on her back on the couch, eyes wide, breathing like a panicked animal. Her sister hovered nearby, eyes just as large.

"Are you hurt?" I asked Angie.

She shook her head, breathing in gasps, and I saw that she clutched her stomach.

"The baby? It's coming?"

She nodded. "I'm afraid," she said. Her chest rose and fell in ragged meter.

I kneeled by her and took her hand. "Angela Turner," I said, "you're a registered nurse and certified midwife. You told me you could deliver this baby in a snowstorm."

"It's too soon," she said between breaths. "My water broke in the crash. She's coming too soon."

"It's not too soon," I said. "Twenty percent of all births start in the 37th week, and there's no appreciable increase in risk. You're a bloody Amazon superwoman, remember? You can do this."

She grimaced. "It's not nice to use my own words against me." She turned to her sister. "Lisa, I need to use your bed. I'll need pillows, towels, a basin of water. Harold, call the nearest hospital and get an ambulance up here. Then boil a pair of scissors. Just in case."

I helped her walk to the bedroom. She shuffled slowly, stopping once and groaning until the contraction passed. I saw that her belly hung much lower

now than it had the day before. She lay on the bed and directed me to prop pillows behind her back, head, and under her legs.

Harold stuck his head in. "They're on their way."

"Tell them to be quick," Angie grunted, "or they'll miss it."

Minutes passed like hours. Angie rocked rhythmically in the bed, panting like someone running uphill. She kept her eyes shut. Lisa looked in several times, but never stayed. I wasn't even sure Angie knew I was there, she was so focused on what she was doing. I stood next to the bed, watching her, but I didn't know whether to touch her or leave her alone.

The contractions grew longer and more intense. As another one began, Angie gasped, grabbed my hand, and started to moan. She held the moan like a note, drawing it out, her face taut with pain. When it passed, she said, "Talk to me."

I had no idea what to say. "You're doing great," I tried. "You can do this."

"No, something else, talk to me about something else. Distract me."

I thought hard. "You're going to miss your chance to shock your classmates," I said. "And I'll miss my chance to slow dance with a pregnant woman. How many people there do you think . . ."

"Okay, be quiet."

"I thought you wanted . . ."

"Shut up, just shut up! Sorry—she's coming!"

Angie screamed. It was a ferocious sound, half-scream, half-growl: a feminine roar of determination. She bore down with every muscle in her body, her whole attention turned inward. Her face turned red and sweaty. I wanted to run and shout for the ambulance, but I couldn't leave her.

When the contraction passed, she lay spent and gasping. "So fast," she said. "It's never been this fast."

Lisa came in. "The ambulance is here, but it can't get across the bridge. They

want you to come out."

"Too late," said Angie, and screamed again. I'd never felt so helpless. I wanted to touch her, soothe her, make everything all right, but there was nothing I could do.

Instead, I stood awkwardly by the bed, my hands by my side, and watched. Please, God, don't let her die. She screamed again and arched, the skin on her neck stretched tight across tendons and veins. I'd never seen such pain. There was something wrong. This couldn't be normal. She was dying; I could see she was going to die.

Lisa stood frozen, gaping at her sister.

"Get somebody in here!" I shouted.

Lisa ran out. She nearly collided with a paramedic on his way in.

"Ma'am, my name's Henry, and I'm on a special birthing team," he said to Angie. "I'm just going to check and make sure everything's fine."

I could have screamed at him. Couldn't he see she wasn't fine? He seemed almost cheerful as he snapped on rubber gloves, then examined Angie.

"Good orientation," he said. "It's past the turn. Won't be long now. Boy or girl?"

Angie grunted. "A girl," she said.

I was astonished to hear her speak.

"She's going to be all right?" I asked.

"She'll be fine. It's almost over. Look, you can see the head."

I looked and saw a cap of dark, wet hair. Amazed, I told Angie, "You're doing it. It's almost over. You're doing it."

She gave a scream that curled her whole body into a muscular ball. At first, nothing happened, but then, all at once, the whole baby flooded into a towel in the paramedic's arms. He expertly cut the cord, wrapped the towel around the baby, and placed her on Angie's chest. The baby let loose a squeaky cry. Angie laughed.

I cried. I didn't even notice at first. I was so overcome by relief that only later did I realize that my cheeks were wet.

The baby crinkled her face and waved

a tiny, clenched fist. She was wrinkled, bloody, and smeared with a white butter I knew from my readings was called vernix. Her eyes crossed. Hair sprouted from the tops of her ears.

"She's beautiful," said the paramedic. "A little blue, but I'd give her an APGAR of eight."

I sat on the bed next to Angie and ran my fingers through her hair. "You did it," I said.

She grinned at me. "Want to hold her?"

I took the wrinkled, bluish-brown baby and cradled her awkwardly. I'd expected the vernix to be slimy, but it had a pleasant texture: a little sticky, but soft.

"That's good for her," said Angie. "You can rub that into her skin."

The baby started to cry. I walked her to the window, rocking her and whispering soothing words. I looked at her chubby arms, the folds of skin under her neck, the fine hair down her back, her dark, half-closed eyes. I counted her fingers and toes.

Outside, the ambulance disgorged a stretcher and other paraphernalia. Two police cars parked alongside. A helicopter roared over the fallen bridge toward me and touched down next to the house. When the blades stopped churning, a blond, fortyish woman in a suit jumped out, followed by a man with a diaper bag and an infant car seat. The room began to fill with people I didn't know.

The blond woman marched straight to Angie's bed. She was older than she appeared from a distance, with heavy make-up to hide it.

"I don't know what to say to you," she said in low, furious tones. "Tell me, what should I say to you?"

"The baby's fine," said Angie.

"That's not the point. You signed a contract; you're expected to honor its terms."

"The contract allows for travel."

"Within easy reach of a hospital! What do you call this?" The woman threw out

her hands, indicating the cabin.

"There was an accident."

"I saw. I heard. Why do you think I'm here? Where's the baby?"

Angie pointed to me. "There. She's fine."

"Good thing. You were lucky."

The blond woman held out her hands toward me. I stared at her. She wanted me to give her the baby. After all I had just seen, after all Angie had endured, this stranger wanted to breeze in and take Angie's baby away.

"You're going to take her in a helicopter?" I asked.

"Of course not. We have a car. Now, please?"

I didn't move.

"Darling, this is my boss," said Angie. "She's from the agency. She's here to take the baby to her legal guardians."

My mind jammed. I couldn't think why I should comply. I had insane visions of running out of the cabin with the baby, losing pursuit in the woods, taking a new identity, contacting Angie when we were safe.

"I don't have time for this," said the blond woman. She lifted the child out of my arms. I didn't resist. I watched her aide dress the baby in a disposable diaper and white cotton gown and then strap her into the car seat.

"This conversation isn't over," the woman said to Angie. "Come see me when you've recovered."

They left. Through the window, I saw them put the car seat in a waiting Volvo and thread the seatbelt through the clasps. They climbed in beside it. The Olds departed, raising dust.

Once they were gone, Angie cried. I sat on the edge of the bed and held her, not speaking. Eventually, she said, "It's always like this. I cry for days, and I hate myself. After a few weeks, I miss the baby so much that I want another one growing inside me, to ease the pain of the last. I go back to the clinic, and it starts all over again." She wiped her eyes. "But now that's going to change. I

submitted the paperwork for a license. Next time, I'm having one of my own."

They transferred Angie to a nearby hospital. The police forced me to wait with my car until a crane came to pull it out. The hood was crushed and the underside scraped, but to my surprise, the car still functioned. After endless questions and paperwork, they released me.

According to Lisa's directions, the hospital lay on the other side of the mountain. I drove carefully in the growing darkness, navigating jagged cutbacks up the slope. Trees flickered by on either side. At the top, the trees cleared to reveal a rocky overhang. I pulled over, stopped the car, and climbed out.

I crunched through gravel to the edge. The valley lay draped in a glistening haze. I saw miles of dark trees, clusters of houses, steepled churches, headlights winding along a distant highway. On the eastern horizon, where the haze met the sky, I could see a glow, probably from Port Jervis on the far side of the river. Only seventy-five miles beyond that lay New York City, the largest concentration of humanity in the world. Somewhere out there, the new baby would be meeting her legal guardians. She'd be loved by someone, protected, held close, but for me, as unreachable as Mars.

My eyes drifted to Antares, gleaming redly at the heart of Scorpio. When Mars passed near it every two years or so, even experienced stargazers had some trouble telling them apart. I slipped the mission director's business card out of my pocket. Was it the real thing? An opportunity for success and happiness? The chance to do something important with my life?

I rubbed my hands together. They felt smooth and soft from the vernix on the baby's skin. I stared at the business card for a long time. Finally, I dropped it. It fluttered off in the breeze, spiraling down the slope and out of sight.

I climbed back into my car, turned on the radio, and drove down toward the hospital. ■

Back in Time Through Other Dimensions

The subject of this column brings to mind an old physics-based limerick (one of the clean ones) that I learned many years ago in graduate school. It goes something like this:

*There was a young lady named Bright,
who could travel much faster than light.
She set out one day,
in a relative way,
and returned on the previous night.*

The physics behind the limerick is that within Einstein's special theory of relativity there is a subtle connection between faster-than-light and backwards-in-time travel. If you could do one, then in principle you could also do the other. But relativity is carefully contrived to prevent superluminal and back-in-time travel and communication.

To physicists, these prohibitions are something of a comfort, because they evade problems with mind-bending consequences that we don't know how to solve. Even sending *messages* backwards-in-time has mind-bending consequences and has become a standard theme in science-fiction (examples: Isaac Asimov's "thiotimoline" pseudo-science-fact articles in *Astounding*, Greg Benford's *Timescape*, Jim Hogan's *Thrice in Time*, etc.).

In the real world, we seem to be prevented from sending back-in-time messages by that least-understood law of physics, the Law of Causality, which is the requirement that a cause must precede its effects in all reference frames. However, new cracks may be appearing in the iron wall of causality. In this col-

umn, I want to discuss some recent work at the boundaries of string theory and general relativity that seems to offer a way to circumvent the back-in-time barrier.

Some of the modern variants of string theory describe our universe as a 3+1-dimensional space-time "brane," essentially a thin 4-dimensional membrane embedded in a higher-dimensional space (for further reading, see my AV column in the May 2003 *Analog*). Almost all of the known particles (electrons, quarks, photons) are restricted to this 4-brane and can move only within it. Further, the three strongest forces (strong, weak, and electromagnetic) are allowed to act only within the brane. Therefore, for most purposes the 3+1 dimensional brane is the only relevant universe, since almost nothing can go outside it.

However, according to some models, the force of gravity gets special treatment in extra dimensions. It is free to leave the brane and spread out into the large extra dimensions in which the brane is embedded. This provides an explanation of why the force of gravity is so weak compared to the other forces: the lines of force for gravity can spread out into the other dimensions, leaving fewer force lines and a much reduced force strength on the brane itself.

Building on this basic scenario, theoretical physicists H. Päs and S. Pakvasa of the University of Hawaii, and T. J. Weiler of Vanderbilt University (I'll call them PPW) have constructed a scheme for back-in-time communication. The starting point

of their scheme is to examine the relativistic “enforcement rules” that normally prevent back-in-time communication. These rules are the Lorentz transformations, devised by Albert Einstein to describe how space and time behave when the observer or the object observed is moving near the speed of light. Within these rules, there is no possibility of superluminal or back-in-time communication.

PPW demonstrate that it is relatively easy to describe an extended universe in which the Lorentz transformations are strictly observed on the brane, but not in the outside “bulk” occupied by the extra dimensions. In particular, within the bulk volume of the extra dimensions the limiting speed (i.e., the speed of light) may be different from its value on the brane. They construct a plausible space-time metric in which the off-brane limiting speed is superluminal and grows quadratically with distance from the brane. This “asymmetrically warped brane universe” is rather like an onion, with each “onion layer” in the bulk having its own limiting speed and its own Lorentz transformations. In such a universe, trajectories that cut across such onion layers are not “Lorentz invariant,” i.e., they can break the local speed limits.

Having found a space-time metric to describe a plausible brane universe, PPW consider a path that leaves the brane, travels some distance in the extra-dimensional bulk outside, and then re-enters the brane. They show that such a path, while it may facilitate moving from one point in space to another at the equivalent of a faster-than-light speed, would *not* in itself represent backwards-in-time signaling (which they refer to as a “closed timelike curve”). For example, if you could make an extra-dimensional jump from here to Alpha-Centauri in six months, that would be a remarkable feat, but it would not in itself produce any problems for the Law of Causality.

However, PPW go on to consider a more elaborate scenario in which a sig-

nal passes out along one such trajectory and then returns to its 3-space starting point along another trajectory in extra-dimensional bulk, with the two trajectories threading through bulk regions with differing limiting speeds. They show that if the extra-dimensional speeds have the right relationship, one can construct a situation in which a signal following this path arrives *before* it is sent. This constitutes a “timelike loop,” and therefore, it produces a violation of the Law of Causality.

Is this a valid calculation, or did they do something illegal in their use of general relativity? Fortunately, the general relativists have devised several ways of evaluating the merit of calculations of this kind. Such evaluations are based on how well a calculation satisfies various energy conditions that have been suggested as possible “rules of the game” for what our universe will allow. (See the discussion of such rules in my AV column “‘Outlawing’ Wormholes and Warp Drives” in the May 2005 *Analog*.) The PPW scheme for producing a timelike loop does well with these energy conditions, satisfying the null, weak, and dominant energy conditions on the brane and violating only the strong energy condition. We note that the strong energy condition is also violated by some well-known quantum processes.

This all sounds very nice, of course, but it raises the crucial question of just how one might manage to send a signal along a trajectory through the extra dimensions outside this brane we call home. PPW suggest a way of doing this. According to the version of string theory that they use, there are two particle-types that are not constrained to stay within the brane of our universe. These particles are gravitons and sterile neutrinos. These can be considered as possible carriers of the PPW signal.

As signal carriers, gravitons (quantum gravity waves) can probably be ruled out, at least for the near future. LIGO, the

biggest and most sensitive detector of gravity waves that our best earth-bound technology can produce (See my AV column on LIGO in the April 1998 *Analog*), has been in operation for several years and so far has reported no detection of gravity waves from any sources, including super-intense sources like merging neutron-star or black-hole binary systems. If it's hard to detect a strong gravity wave, it should be even harder to use them for signaling. There have been some recent ideas about the generation and detection of high-frequency gravity waves, which may make the signal transfer problem easier, but presently there is no technology for doing this.

That leaves sterile neutrinos, which will require some explanation. According to the standard model, there are three "flavors" of neutrinos: e, mu, and tau. These are the neutral "twins" of the electron, the mu lepton, and the tau lepton. From recent measurements with the SNO and Super-K neutrino detectors, we now know that a neutrino of a given flavor can "oscillate" into other flavors as it travels some distance. For example, SNO measurements tell us that about 2/3 of the e-type neutrinos produced in the Sun have oscillated into mu neutrinos before arriving at the SNO detector buried deep in a mine in Sudbury, Canada. The Super-K neutrino detector in Japan has provided evidence that the mu neutrinos from cosmic rays oscillate into tau neutrinos on their way to the detector.

Overall, there have been a number of large neutrino detector experiments studying neutrino oscillations in one way or another, and all but one of them give a consistent picture. The wild-card experiment is the LSND measurement at Los Alamos, which measured neutrinos made with the very intense 800 MeV proton beam from the LANSE (formerly LAMPF) accelerator and ran from 1993 to 1998. The neutrino detection measurements from LSND do not fit with the other measurement results. The possibilities are (a) LSND has some funda-

mental error, or (b) it is observing the oscillation of muon neutrinos into a hypothetical fourth flavor of neutrino called "sterile neutrinos." Possibility (a) is now being checked by the mini-BOONE experiment at Fermi Lab.

If LSND did observe the oscillation of mu neutrinos into sterile neutrinos, that's a very interesting result, in the context of the present discussion. Sterile neutrinos do not participate in the weak interaction, and are allowed to leave our brane in the same way as gravitons and to have trajectories involving the extra dimensions. Therefore, if sterile neutrinos exist, there is a possible experimental test of the PPW ideas.

One could imagine an experiment in which a modulated beam of mu neutrinos produced by collisions and decays at a large accelerator are beamed down into the Earth, where they oscillate into sterile neutrinos, go on an excursion in other dimensions, oscillate back to mu neutrinos, and are detected by a large detector located at some large distance around on another side of the Earth. According to PPW, if that trajectory was just right, the signal just might arrive *before* it was sent.

The SF implications of back in time signaling are fairly obvious, but let's consider them. If you receive a signal from the future, you can either (a) take actions that are consistent with the message, or (b) take actions that are inconsistent with it. Under scenario (a) you might receive tomorrow's winning Power-Ball Lotto number, buy a ticket for that number, win the lottery, and then send your past self a message containing the winning number to complete the loop. Under scenario (b) you might receive a message warning that tomorrow you will be killed in a car accident, so you carefully stay home, avoid the accident, and change the future.

How, exactly, the universe deals with such positive (a) or negative (b) timelike loops depends on your model of how to

resolve time-travel paradoxes. The deterministic scenario is that the future is fixed and cannot be changed, so only scenario (a) events are possible. In some scenarios, usually not well defined in their implications, a scenario (b) event causes the old future to fade away and be replaced by a new future. The novels *Timescape*, *Thrice in Time*, and many other SF works implicitly use this model. A third model, based loosely on the many-worlds interpretation of quantum mechanics, is that a scenario (b) event produces a branch universe in which history follows a different path. In my novel, *Einstein's Bridge*, I used yet another model in which the creation of a timelike loop "unravels" the universe back to the beginning of the loop, so that it can proceed on a different path.

There are probably even more ways

of dealing with time-travel paradoxes. If PPW are correct, we may have to start thinking seriously about them. ■

AV Columns Online: Electronic reprints of over 120 "The Alternate View" columns by John G. Cramer, previously published in *Analog*, are available online at: <http://www.npl.washington.edu/av>. The preprint referenced below can be obtained at: <http://www.arxiv.org>.

Reference:

Closed Timelike Curves:

"Closed timelike curves in asymmetrically warped brane universes," Heinrich Päs, Sandip Pakvasa, and Thomas J. Weiler, ArXiv preprint gr-qc/0603045 (March 13, 2006).

IN TIMES TO COME

The lead story in our November issue is a new novella by a writer too long absent from these pages: Barry B. Longyear. I'll leave you to try to guess exactly what "The Good Kill" is about, telling you only that it involves a wildly different kind of business venture and a wildly different kind of detection, both growing out of a very old tradition practiced in a very new (and occasionally quite silly) way. I don't think you'll be disappointed, and I'm sure you'll be entertained.

Shane Tourtellotte's quietly thought-provoking novelette "Where Lies the Final Harbor?" shows us a future heavily dependent on a profession in which human beings are routinely required to make superhuman sacrifices—which raises the question of how they should be paid.

We'll also have stories by Carl Frederick, Mike Resnick, and Kevin J. Anderson, those last two in collaboration. The science fact article is also a collaboration, in which space experts Les Johnson and Gregory L. Matloff examine some of the current research that could eventually pave the way for interstellar travel.

Last but by no means least, we'll have Part II of Robert J. Sawyer's four-parter *Rollback*.

SETI Triumphant

Richard Thieme and Aaron Ximm

We have been sending signals, one way or another, for centuries, and listening for a reply, thanks to the creaking machinery of that ancient looking-for-a-message-in-a-bottle process we affectionately call SETI.

Never mind that Earth cultures long ago abandoned radio waves and adopted lower-register gravity waves for near-instantaneous transmissions to near-star systems.

And never mind that only a few hobbyists know how to build radios.

And never mind that our tiddlywink style of exploring neighboring systems has turned up nothing but rudimentary life forms.

Never mind all that. Religious rituals die hard even in our enlightened times and radio-band SETI searches are definitely a religious ritual. Custodians of the project, spending the accrued interest from an endowment that has grown bloated, are dug in and locked down.

So radio-signal sending has continued for centuries because we had the motive, the means, and the opportunity.

I don't think anyone really expected

to hear anything back. Even diehard SETI-ists greeted the announcement with disbelief. One can announce the second coming only so many times before true believers stop selling their furniture and heading for the hilltops. "Yes, maybe the Prophet is right," one learns to say, "but . . . let's wait and see."

This time, however, it happened. The design of dashes and dots was undeniable. Not in clouds of glory had the extraterrestrial message come, but as coherent digital signals enclosed in code wrappers.

Those wrappers were tough to detach. They consisted of braided twists of alien symbols, hundreds of them, interlocking in complex patterns, and it took a massive cracking consortium using Monolith Links in four systems to distinguish the meaningless (to us) hieroglyphics of the alien race from the lucid Chingleese that remained when the wrappers were removed.

The message was distressingly clear.

So we now have a bona fide response to all those messages in all those bottles. But which one did they receive? To which of our many communications do

they refer?

Hence this broadcast to all human-cyborg-kind-and-kin in near systems. If any of you has so much as a clue how we might respond, please transmit to Central Station immediately.

The problem is not trivial. Our forebears transmitted millions of ancient and modern messages from "Hello, Rainey," to weekly installments of WormHole Runners of HyperSpace. We have transmitted on all frequencies, broadcasting in all directions around the spherical bandwidth shell. We have sent the silliest giggles and the most profound insights.

We have sent, alas, everything.

The received message was clearly a response to one of those transmissions. But which one?

Which one?

We must redress the aliens' error in judgment. We are a diverse, multitalent-ed species with many variations. We are a bell-curve of modified life-forms, not a simple species that was merely born. Yet we can't just transmit,

Dear Allegedly Superior Species,

Thank you for your reply. However, to which transmission do you refer?

Perhaps another might be more suitable? Something funnier, perhaps? Or shorter?

Sincerely,

Human-Cyborg-Kind (and kin)

No, that won't work. It would take forever to get an answer back, if they answer at all. I can imagine the blue-tipped tentacle of some clueless intern wiping out our message, oblivious to the implications.

So SETI may be nothing but a monument to the foolish optimism of human-cyborg-kind. At least the sentient life in our little neighborhood can have a good laugh before shooting itself in its collective head with a gun that flaps *BANG!* on a drop-stick.

Enough preamble. Here, dear kind

and kin, is the unanticipated climax of SETI:

Dear Human-Cyborg-Kind,

Thank you very much for your transmission. A majority of systems in the universe have now had time to review it and we believe that you show promise. Even the Blandergsst-thupfft! agreed, and they seldom respond positively to any unsolicited transmission (they stamp "We have heard this before" on every one; given their age, maybe they have.)

While your transmission does suggest a certain quirky creativity, unfortunately you do not meet our current needs. There is, in addition, a backlog of species of your type in the universe, so we will not be reviewing transmissions from your sort for an indefinite period. Please listen to this frequency to learn if this policy changes. Policies are reviewed once every galeemp.

This negative response is in no way a comment on your planetary systems or the life-forms they have produced.

Although we would like to reply to each and every transmission, please understand that with millions of systems broadcasting in thousands of media, an individual response is impossible.

Perhaps a (very young) parallel universe would find your transmission suitable. I believe the Dirnsa are looking for a pet, so you might try the umpteenth bubble in the thirtieth froth. If you do transmit to a universe less than six billion years old, however, remember to include return-energy-bands to ensure a response.

Sincerely,

Lem-Lem-Three-bang!

Designated Receiver of Unsolicited

Flotsam, Jetsam, Detritus, and Fluff

On behalf of HellénWuline

and Associates

Nested at the seventeenth level of the

HoHo Reception Group and interim

assistant to the seventh sub-intern's

fourteenth aide ■

Nigerian Scam

Richard A. Lovett

Humans, and probably other intelligences, come up with all kinds of ways to put things over on eah other—though not always the ones they think. . . .

Ryan Mann was bored. Bored enough to read junk email rather than simply toss it as spam. Frustrated enough to consider answering it, just to see what would happen.

It had been a long, slow summer—a total waste, ever since July 4, when he'd heard a sound like a gunshot in the middle of the Firecracker Criterium bicycle race: forty laps of tight corners on a twelve-block course through the cobbly streets of Old Town. He'd had about a millisecond to process the fact that the bang came from his front tire, and then he'd gone from leading the peloton to being run over by it, somehow managing to break *both* collarbones in the process. Before hitting the ground, he'd been one of the best amateur cyclists in the state; afterward he couldn't even dress himself—or do a few more-embar-

rassing things, for that matter.

Now, he could again reach over his head—sort of, anyway—but he was still laid off from work and had two more no-cycling months stretching ahead. If it weren't for his laptop, Ryan would have gone stark raving mad. It was one of the new ultra-light models that ran on solar power and weighed just under three pounds, which was the maximum they'd allowed him to lift during the first weeks of bone-knitting. "Use it on your lap," the doctor said. "And keep changing the angle so it works your wrists a bit differently every few minutes. Your shoulders aren't the only things messed up by the fall."

He wasn't sure it was good to have a doctor who thought "messed up" was a technical term, but the bottom line was simple: "It'll be great physical therapy."

It was also good mental therapy, be-

cause so much of what was on TV really sucked. Once, just to liven things up, he called the toll-free number for an infomercial, intending to harass the sales reps for a company that claimed he could develop a movie-star build by working out three minutes a day with a device that looked like a giant slingshot. "Oh yes," a perky voice told him when he mentioned his injury. "The WebWam is great for physical therapy. And there's no risk. If you use it as directed and don't get better quickly, there's a money-back guarantee." The trap, of course, was the "if." There was no way Ryan could use it as directed until he was already well on the road to recovery. But she sounded so sincere that there wasn't any sport in arguing with her, so he wimped and said he'd think about it.

Life got better when he found an Internet service that allowed him to download ancient TV shows which, corny as they were, were infinitely preferable to infomercials. It got better yet when he dipped into the world of Internet message boards, swapping cycling lore with fellow athletes and seeking tips on more realistic rehab techniques that might possibly get him into some of the fall cyclocross races—though he couldn't imagine being in truly competitive shape before the snow fell.

Cyclocross was Ryan's favorite form of cycling, combining mountain biking with obstacle courses that force you to dismount and carry your bicycle on the run. But there's only so much time you can spend talking about a sport without doing it. Besides, the message boards were full of trash talkers and trolls. He'd had to look up the latter term the first time he encountered it, but the concept was familiar: irksome individuals who hijack discussion threads into absurd arguments, just to see what they can stir up.

The spam was more interesting than the trolls. Not the "We have Xnx and V-g-r-a" sales pitches, but the darker stuff: the type that makes you wonder how there could be enough idiots in the

world to keep the scammers in business.

This one looked like a variant on the old Nigerian Scam, which intrigued him because it carried a whiff of danger. Rumor said billions had been lost in various incarnations of it. Rumor also said that if you tried to get your money back by chasing the scammers to Nigeria (or wherever they were currently based), you probably weren't coming home except maybe in a body bag. Ryan had no idea if this was true, but it always made his heart race when the scam showed up in his in-box because it meant some real-life gangster-type was trying to target him: one who might have killed people in the past. Not as exciting as leading the Firecracker Crit, but something to think about as he waited for cyclocross.

This message started typically. REQUEST FOR URGENT BUSINESS RELATIONSHIP, it began in the usual stilted prose. PLEASE REGARD US YOUR STRICTEST CONFIDENCE TO THIS TRANSACTION, WHICH BY VIRTUE OF ITS NATURE MUST HAVE MAXIMUM DISCRETE CIRCUMSPECTION.

Somewhere, a whole team of grifters must have labored over the language, including the archaic, all-caps formatting. Ryan wondered who they thought they were impersonating. Octogenarian bankers in trilbies? Still, the message had caught his attention, despite its seriously retro introduction.

IN EXCHANGE FOR YOUR RELIABILITY IN THIS "TOP SECRET" MATTER, it continued, I AM AUTHORIZED TO COMMENCE BUSINESS ON BEHALF OF GOVERNMENT OFFICIALS NEEDING ASSISTANCE IN IMPORT/EXPORT BUSINESS.

The classic Nigerian Scam would then seek his help in a money-laundering scheme in which (ultimately) it would be his money that would get laundered. But this one turned weird.

WE HAVE INFORMATION IN THE PLANETARY SYSTEMS OF OUTER VEGA, TO WHICH WE AFFORD EXCHANGE FOR YOU IN MONEYMAKING PLAN OF RECIPROCAL DATA FROM PLANET EARTH. THE SOURCING OF VALUABLE INFORMATION IS AS FOLLOWS: THE PERSONALITIES OF OUTER VEGA ARE TECHNOLOGICALLY SUPERIOR TO THOSE OF EARTH, BUT DUE TO 'NON-INTER-

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REFERENCE' DIRECTIVE, OUTER VEGAN TRADE-CONTROL AGENCIES REFUSE TO PROVIDE EARTH PEOPLES WITH SAID INFORMATION. OUR BELIEF CONCLUDES THAT THIS IS BECAUSE TRADE CONTROL AUTHORITIES ARE INCALCULABLY WEALTHY AND DO NOT APPRECIATE VALUE OF MODEST GAINS FOR INDIVIDUALS DESIROUS OF FINANCIAL IMPROVEMENT.

I AND OTHER 'CIVIL SERVANTS' WITH ACCESS TO TACHYON COMMUNICATION DEVICES BELIEVE THAT YOU ARE ADVANCED ENOUGH FOR TECHNOLOGY TRANSFER, PROVIDING PRUDENCE IS EMPLOYED FOR CONTINUANCE OF YOUR SOCIETY. WE THEREFORE OFFER INITIAL EXCHANGE: EVEN THOUGH YOU ARE INFERIOR, YOU HAVE INTRICATELY HISTORIED RECREATIONAL CONCEPTIONS NOT IMMEDIATELY EXPLICABLE TO OUR XEONOGRAPHERS, INCLUDING 'BICYCLE RACING' AND 'CLASSIC TV SITCOM'.

IN ORDER TO COMMENCE BUSINESS WE SOLICIT YOUR ASSISTANCE TO ENABLE US TO TRANSFER INTO YOU INFORMATION OF VALUE COMMENSURATE TO DATA REGARDING 'BICYCLE' AND 'CLASSIC TV SITCOM', WHICH WE BELIEVE TO BE WORTH APPROXIMATELY 40,000 OUTER VEGAN GRAND STARS, OR \$32,690,000 (THIRTY-TWO MILLION, SIX HUNDRED AND NINETY THOUSAND U.S. DOLLARS). WE HAVE IDENTIFIED YOU AS OUR CONTACT OF CHOICE BECAUSE YOU ARE NOTED AS A BICYCLE RACER WITH HONORABLE PROMINENCE IN ELECTROMAGNETIC NEWS BROADCASTS OF YOUR LOCALITY. OTHER RECORDS SHOW THAT YOU ARE IN THE TOP 0.01 PERCENT OF YOUR LOCALITY'S CONSUMERS OF CLASSIC SITCOMS, INDICATIVE OF ESTIMABLE EXPERTISE.

PLEASE ACKNOWLEDGE INQUISITIVENESS OF ASSISTING US BY REPLYING TO THE FOLLOWING ADDRESS: INTERSTELLAR-RICHES@OVIC.OUTERVEGA.UNI, LATEST 24 OF YOUR HOURS FROM RECEIPT OF THIS IMPLORATION.

SINCERELY,

GLEIMICKR

INFORMATION BROKER

OUTER VEGAN INFORMATION CONSORTIUM
(OVIC)

Ryan read the message five times: the first two to parse the grammar; the next three with increasing appreciation for the grifter who'd forged it. It really did

look as though someone with a poor grasp of English had latched onto the Nigerian Scam as a model for Internet business offerings.

He reached for the delete key, then hesitated. This was the most interesting thing to cross his computer in days. He grinned. Here was his chance to make up for being too nice to the slingshot rep. Assuming it wasn't all a joke, Ryan was going to troll the spammer. Besides, he was intrigued by the bicycling connection. Either it was blind luck, or someone had taken time to target him individually. His spectacular crash hadn't exactly been "honorable prominence," but it had been all over the evening news. The fact that the scammer seemed to know about his sitcom binge was a bit creepier, but there were probably plenty of ways for a skilled hacker to get that kind of information.

His first impulse was to write back saying something on the order of, "Oh, goody, goody, tell me what to do." But that probably wasn't how a real mark would react. All but the most gullible (plus maybe a few UFO freaks) would show caution. In fact, he'd read somewhere that most people who fell for the Nigerian Scam started with questions, then got hooked by their secret hope that maybe the offered riches really existed. Ryan was smarter than that. He couldn't quite figure how this Gleimickr character expected to scam him, but the key to finding out lay in adopting a tone that looked appropriately cautious without giving away the fact that he knew there were no riches. Nor an Outer Vega, for that matter.

Eventually, he decided that simplicity was best. "Dear Gleimickr," he typed. "If you are from Vega, how can communicate by email?"

The reply was back an hour later.

DEAR MR. MANN,

THANK YOU FOR YOUR QUERY OF EXCEL-

LENCE. I GIVE YOU THE ANSWER IN TRUST THAT YOU DO NOT 'BLOW THE WHISTLE' TO MY SUPERIORS. OUR TACHYON DEVICES EXIST TO TRANSMIT NONCORPOREAL INFORMATION BETWEEN CONFIGURED RECEIVERS. HIGHEST-SPEED DATA PROCESSORS CALLED 'SUPERCONDUCTING SUPERCOMPUTERS' REVEAL THEIR EXISTENCE BY MEANS OF TACHYON EMISSIONS NOT DETECTABLE BY YOUR SCIENCE. OBSERVING RECENT EMISSIONS FROM YOUR PEOPLES, WE TUNED OUR TACHYON DEVICES FOR BI-DIRECTIONAL COMMUNICATION WITH SAID SUPERCONDUCTING SUPERCOMPUTERS. THIS MESSAGE IS CIRCULATING VIA LOCATION CALLED 'CENTRAL INTELLIGENCE AGENCY'.

SINCEREST REGARDS,
GLEIMICKR
OVIC

"So you're telling me that you're hacking the CIA?" Ryan wrote back.

This time the answer took several hours.

DEAR RYAN,
THANK YOU FOR YOUR CURIOUS UNDERSTANDING. MY APOLOGIES FOR DELAY WHILE I RESEARCHED TERM 'HACKING'. YES WE ARE MAKING UNAUTHORIZED ENTRY TO HOST COMPUTER, NOT FOR EVIL NEFARIOUSNESS BUT BECAUSE IT IS AN EFFICIENT MACHINE FOR COMMUNICATION. IS 'HACKING THE CIA' A BAD THING? IT IS NOT THE ONLY COMPUTER LOCATION THAT CAN USED WITH FEASIBILITY.

AWAITING YOUR RESPONSE,
GLEIMICKR

This was way more entertaining than infomercials. "Yes," Ryan typed. "It's a seriously bad thing."

THANK YOU FOR YOUR KIND ADVICE, Gleimickr wrote back the next morning. WE ARE NOW WORKING THROUGH ORGANIZATION CALLED UNIVERSITY OF MICHIGAN. IS THAT BETTER?

"Yes. Though I'm sure it's still illegal." Not that Ryan believed that any such thing was actually happening. Time to

take the offensive again. "But how can you live in the star system we call Vega? I took an astronomy class in college and Vega is a blue-giant star, which means it produces a lot of dangerous radiation. Also, how can there be more than one planetary system at a single star?"

He punched the keys with vicious delight. *Those* were questions he bet his correspondent hadn't thought of.

But the answer came back with little delay.

YOUR CORRECTNESS IS NOT WORTHY. THIS IS WHY WE ARE THE PEOPLES OF OUTER VEGA. INNER VEGA IS NOT HABITATION WORTHY. AS FOR MY USE OF THE STATEMENT "PLANETARY SYSTEMS", THAT WAS A MISTAKE OF YOUR LANGUAGE, WHICH IS VERY CONFUSING. WE ARE A CONSORTIUM OF PEOPLES FROM MORE THAN ONE PLANETARY SYSTEM. ONCE, WE TRAVELED AMONG OUR PLANETS OF ORIGIN BY 'SPACE-SHIP', BUT THE TRAVEL TOOK VERY LONG. NOW, WE TALK BY TACHYON DEVICE AND SEEK RADIATIONS INDICATIVE OF DISTANT CULTURES FOR POSSIBLE INFORMATION EXCHANGE. THEY ARE INFREQUENTLY DISCOVERED BECAUSE UNFOCUSSED TACHYON EMISSIONS DISPERSE BY INVERSE-SQUARE LAW AND BECOME DIFFICULT OF DETECTION AT DISTANCE OF YOUR PLANET.

ARE YOU NOW READY TO MAKE BUSINESS?
GLEIMICKR

"One more question. Why do you need me? If your tachyon devices can hack the CIA and read the Internet, can't you find everything you want there?"

THAT IS ANOTHER QUESTION OF EXCELLENCE. YOUR INTERNET IS INDEED AWASH WITH INFORMATION. UNFORTUNATELY EACH DATUM IS CONTRADICTED BY MANY OTHERS. THIS IS MYSTERIOUS TO US. AN EXAMPLE: THERE ARE WEBSITES ASSERTING THAT NO PEOPLES HAVE EVER LANDED ON YOUR MOON, WHILE OTHERS SHOW APOLLO CREATURES IN THAT LOCATION. ADDITIONAL WEBSITES DESCRIBE ABDUCTIONS BY ENTITIES OF WHICH WE HAVE NO KNOWLEDGE, ARGUE ABOUT THE AGE OF THE UNIVERSE, OR DISPUTE INFORMATION THAT CAUSES OUR XENOGRAPHERS TO

ANALOG

BE UNCERTAIN ABOUT BASIC ISSUES REGARDING YOUR SCIENCE. THERE ARE EVEN WEBSITES DESCRIBING YOUR WORLD AS RIDING ON THE BACK OF A CREATURE CALLED A 'TURTLE', ALTHOUGH WE FIND THIS UNLIKELY. ALL TOLD, YOU ARE THE MOST DISCORDANT PEOPLES WE HAVE EVER ENCOUNTERED.

WE MIGHT EVENTUALLY UNRAVEL THE INCONGRUITIES AND MAKE BUSINESS WITHOUT ASSISTANCE, BUT LIFETIMES ARE NOT INFINITE. INFORMATION EXCHANGE COSTS NOTHING TO GIVE, AND IS MORE EFFICIENT. BECAUSE OUR SUPERIORS HAVE NOT APPROVED TRANSACTIONS WITH YOUR PEOPLES, HOWEVER, WE MUST RESTRICT OURSELVES TO INFORMATION WHICH WITH GOOD TIME AND FORTUNE WE MIGHT CLAIM TO HAVE GLEANED FROM YOUR INTERNET, UNASSISTED. WE ARE THEREFORE SEEKING YOUR SENSICAL COMMONALITY IN UNDERSTANDING THE ALREADY-ACCESSIBLE INFORMATION, FOR WHICH WE OFFER TECHNOLOGY TRANSFER OF RECIPROCAL VALUE.

Ryan laughed. "I think it's called common sense," he wrote. "How do I know I can trust you?"

ARE NOT ALL BUSINESS RELATIONS PARTIALLY BUILT ON TRUST? BUT TO PROVE GOODWILL, WE OFFER, GRATIS, INFORMATION THAT MIGHT BE RELATED TO OUR MUTUAL INTEREST: 'THE BICYCLE'.

REVIEWING THE 'TV' TRANSMISSIONS REGARDING YOUR BICYCLE-RACING FAME, WE FIND THE BICYCLE TO BE AN INGENIOUS APPLICATION OF PHYSICAL PRINCIPLES WELL KNOWN TO OUR SCIENTISTS BUT NEVER APPLIED TO LOCOMOTION. NONETHELESS, WE ARE UNCERTAIN ABOUT MANY FACTORS. FOR EXAMPLE: IS IMPACT WITH THE GROUND AN INTENDED PART OF 'RACING'?

Ryan laughed again. "No."

THAT IS AS WE THOUGHT. SEVERAL OF OUR PEOPLES' ANATOMIES ARE SUFFICIENTLY SIMILAR TO YOURS THAT WE BELIEVE WE CAN ENTHUSE BICYCLE RACING AS A SPORT AMONG OUR SCATTERED WORLDS, ESPECIALLY IF YOU GUIDE US IN UNDERSTANDING 'STRATEGY' AND 'TACTICS' AND TELL US WHICH OF THE 1,283 MANUFACTURERS THAT CLAIM TO BE 'THE BEST' REALLY IS. ALSO,

PLEASE EXPLAIN THE BASIC PRINCIPLES OF AVOIDING UNINTENDED CONTACT WITH THE GROUND.

IN EXCHANGE I OFFER A DEVICE WHICH CAN CONVERT UNINTENDED CONTACT WITH THE GROUND INTO 'NEAR' CONTACT WITH THE GROUND. IT IS CALLED A 'GRAVITY INVERTER' AND CAN BE BUILT WITH PARTS OBTAINABLE FROM AN 'ELECTRONICS STORE' FOR LESS THAN 95 OF YOUR DOLLARS. AS A GESTURE OF OUR FAITHFUL INTENTIONS, SPECIFICATIONS ARE ATTACHED.

Ryan carefully searched the attached file for viruses, then downloaded it. It was indeed a schematic for an electronic device, though the component specifications weren't in units he understood. Rather, everything was scaled to the voltage of the power supply, allowing him to pick any power supply he wanted. Did that mean Gleimickr wanted him to believe it would work as well with a pack of AA batteries as with a 110-volt DC converter? He had no idea, but in high school, one of his favorite classes had been shop, and it had been a long time since he'd had an opportunity to play around with soldering, machining, and circuit construction. A few of the components had rather exotic names, but he could definitely put the thing together, presuming his local store truly sold the parts. Along with the schematic was a second file, which contained computer software that he was supposed to load into a processor that was the device's most costly component.

Ryan wondered again what the hypothetical mark would do. That's when he realized he was getting ahead of the game. The mark wouldn't just go out and build the thing. He'd ask what the hell it was supposed to do.

IT USES A FUNDAMENTAL PRINCIPLE NOT YET DISCOVERED BY YOUR SCIENCE, Gleimickr wrote back. WITH THE INTENSITY CONTROL PROPERLY SET, IT INVERTS THE ENERGY OF GRAVITY TO CREATE A REFLECTION FIELD THAT WILL HALT A FALLING OBJECT SLIGHTLY ABOVE THE

GROUND, WITHOUT CREATING DAMAGING DECELERATIVE STRESSES. THIS EDITION OF THE DEVICE WILL RECOGNIZE SURFACE CONTOURS, SO THAT, WORN ON A BELT, IT WILL PROTECT YOUR ENTIRE BODY BUT WILL NOT ACTIVATE SO LONG AS YOU AND YOUR BICYCLE REMAIN IN CONTACT WITH AN UNDERLYING SURFACE.

Briefly, Ryan forgot his role as an imitation mark. "Cool," he typed, hitting *send* before remembering to ask himself if the remark was properly in character.

It was, he eventually decided, but it meant that he'd committed himself to building the device if he wanted to continue toying with the spammer. But why not? Even if the whole thing was just a ploy to sell electronic supplies (which he doubted), he could afford the \$95: he'd have spent a lot more than that on cycling equipment if he wasn't laid up. And constructing the device wasn't going to take any heavy lifting; in fact, it would be another form of physical and mental therapy. Just to be on the safe side, he'd make a low-voltage version, though, in case the thing was some kind of booby trap designed to blow up in his face the moment he turned it on.

Two days later, Ryan had soldered together a Rube Goldberg contraption that fit into a plastic case the size of a shoebox. It had two controls: an on-off switch and a potentiometer. Gleimickr's specs had called for the pot to be labeled logarithmically in units called choltus, ranging from zero to a million. "THE CHOLTU IS A BODY-SIZE SCALING FACTOR," Gleimickr had explained when Ryan asked. "FOR IMPACT PROTECTION, YOU SHOULD SEEK THE SETTING THAT PUTS YOUR BODY ABOUT ONE-TENTH OF ITS LENGTH ABOVE THE GROUND. SCALE IS DIFFICULT TO DETERMINE FROM YOUR TV IMAGES AND INTERNET WEB SITES, PARTICULARLY BECAUSE MANY OF YOUR VIDEO GAMES AND 'CARTOONS' APPEAR TO BE HIGHLY INCONSISTENT, SO I HAVE PROVIDED A WIDE RANGE OF OPTIONS, MORE THAN COVERING THE GAMUT OF ALL INTELLIGENT SPECIES WE HAVE ENCOUNTERED. IT IS ADVISABLE TO DO INITIAL TESTS AT

LOW SETTINGS TO AVOID BEING EXCESSIVELY ELEVATED. BE AWARE THAT BATTERY LIFE DIMINISHES WITH CHOLTUS, DUE TO THE POWER DRAIN OF CREATING LARGE INVERTER FIELDS. FOR MY CURIOSITY, I WILL BE FASCINATED TO LEARN THE SETTING THAT PROVIDES DESIROUS RESULTS FOR YOUR SPECIES."

When the time came to turn on the device, Ryan stood as far back as possible, pushing the switch with the tip of a ruler. Nothing happened, but that was no surprise, since he'd set the dial to zero.

Building the box, he had decided to ignore Gleimickr's weird units. Too many zeros. The potentiometer he'd bought had a ten-point, click-stop scale, which was a lot easier to use. He could always convert to choltus if the need arose. Now he moved it up a notch, to 1.

Ryan wasn't really expecting anything except perhaps a puff of smoke and a bad aroma, so he was surprised by how disappointed he was when the box just sat there. He turned the dial up to 2, then to 3, and had gotten as high as 6 when he remembered Gleimickr's talk of a surface sensor. Sitting on the table, the device wasn't *supposed* to do anything.

There was an easy solution to that. He picked it up, held it chest high, and let go.

The results were impressive. The box began to fall, then a solenoid hummed, an internal switch flipped with an audible click, and it shot upward. Even as Ryan was jumping backward with a yelp, it impacted the ceiling with a thump. There, it apparently figured out that the ceiling was in contact with walls that were rooted to the ground because there was another click and it began to fall. That kicked the inverter on again, and the box pogoed back upward until it again hit the ceiling, only to shut off and fall anew.

Obviously, 6 was the wrong setting.

Nothing stifles doubts better than an

ANALOG

antigravity device trying to batter through your ceiling. Gleimickr was either what he claimed to be or some kind of eccentric genius, and from Ryan's perspective, the difference was immaterial.

Unfortunately, his injuries meant he had no way to corral the runaway device—though perhaps that was for the better, because he might just have gotten his fingers mashed as he dangled from it, trying to find the “off” switch. As it was, he'd have to wait for the battery to run down or for one of the internal relays to fail so the thing would at least quit its infernal thumping. Or maybe it really would punch a hole in the ceiling and go die in the attic.

Meanwhile, he bought a new set of components and set about building Gravity Inverter, Mark II.

The Mark II had certain refinements of his own devising. To begin with, it was small enough to fit in a fanny pack. Also, Ryan bought an assortment of potentiometers, so he could pick the one whose operating range would preclude “excessive elevation.” Being able to levitate above the treetops might have its uses, but not in bicycle racing, and he didn't want to think about what might happen if he accidentally set the thing on 10.

By the time the Mark I finally ran out juice, Ryan was up to the Mark IV, which seemed trustworthy enough to risk testing on his own body.

He'd tried the Mark III on a stray cat with extremely satisfying results, other than some nasty claw marks and the discovery that it doesn't take much breeze to carry a floating cat away at a speed that's difficult to match on foot. Now, with a gulp, he realized he was ready to attempt for himself some of the experiments he'd done with the cat.

He'd substituted a digital readout for the click-stop dial and switched to finer gradations measured in percentages (though the Mark IV was capable of going only to the 45 percent level). The

optimum setting appeared to be 30, but just to be on the safe side, he set the device at 35, climbed over the railing of his deck, and jumped. If it didn't work, he'd probably break an ankle along with at least one of his mending collarbones.

But work it did. With a nice, springy sensation, the deceleration kicked in well above the ground, rebounded him once, then positioned him with the lowest portion of his anatomy a couple of meters above the grass. From his experiments with the cat (once it had become sufficiently traumatized that it quit attempting to land on its feet), he knew that he'd be equally safe if he fell head-first or belly-flopped, though he didn't have the nerve to try.

Carefully, he dialed the pot toward zero, until, gentle as a feather, he settled to earth. Gleimickr had delivered exactly what he'd promised.

Over the next few weeks, Ryan wasn't sure which he wanted more: to get back into bicycle racing or get rich. Luckily, he could do both.

By the time he'd tested the Mark V, he was strong enough to lean on the handlebars, but it would be a month before he could risk a second fall. Now he didn't have to worry. But he still couldn't lift his bicycle over the cyclocross obstacles, so, in exchange for an explanation of the difference between titanium, carbon-fiber, and aluminum bicycle frames, he persuaded Gleimickr to show him how to convert the crash-protector into a weight-neutralizer that he could place beneath the seat of his bicycle. A discreet flip of a switch would cancel 95 percent of the bicycle's weight, so that when he needed to lift it, he could swing it up, light as a feather: though he had to be careful, because it still retained full inertia—something he discovered the hard way, bashing his head on a pedal.

The gravity neutralizer allowed him to practice on obstacle courses, despite his injury, which was a lot more fun than

just riding the roads. It also allowed him to return to competition. It wasn't exactly fair, but Ryan couldn't imagine that anyone had ever written a rule against such devices. And, he reasoned, innovation had always been part of the sport. Besides, he was lucky to be *racing* this year. Winning was out of the question, so who was hurt?

Meanwhile, he needed a patent attorney to help him cash in on Gleimickr's gift.

Obviously, cycling was a specialty market. But it didn't take a genius to realize that by tinkering with scale, the gravity neutralizer became an antigravity sled. So Ryan offered Gleimickr a trade. He would write a 10,000-word treatise contrasting "I Love Lucy," "The Dick van Dyke Show," and "Seinfeld" with contemporary reality-coms like "Insult Flame-War" and "Gross-Out Master." In exchange, Gleimickr would tell him how to convert the inverter into a sled and, for good measure, a freight elevator.

Gleimickr agreed, with one caveat. YOU NEVER TOLD ME WHAT SETTING YOU'RE USING. MY CURIOSITY LINGERS.

Oops, Ryan thought, and flashed Gleimickr a photo of himself floating above his bed (he'd discovered that the neutralizer made a great sleep aid), with the digital readout clearly visible. "Sorry about that."

He quickly learned, though, that emailing the same photo to a patent attorney was a sure-fire way *not* to get an appointment. After four rejections, he simply picked the next attorney on his list and walked in, armed with the Mark VI, which was merely the Mark V with a power gauge so he wouldn't find out the hard way when the batteries wore out.

"Hi," he said. "I have a new invention." He turned it on, jumped up, and hovered—adjusting the control so that he bobbed entertainingly in front of the slack-jawed attorney. "Think you can help me market it?"

"Uhrb," said the attorney.

Of course it wasn't quite that simple. Especially when Ryan told him about the freight elevator.

"Uh, there's one problem with that," the attorney said.

Ryan nodded encouragingly. Problem solving was why he needed help. On his own, he'd have no option but to hand the device over to a big company and take his chances. "Yes?"

"Suppose you use your freight elevator to lift a big tank of water, then dump it down a pipe that feeds an electrical generator. From what you're saying, you could produce more power than it takes to do the lifting."

Ryan hadn't thought of that. "Wow. Goodbye, energy shortages."

"Maybe. The problem is that it's a form of perpetual-motion machine. The Patent Office isn't kindly disposed toward those."

"Oh? Then show them this." Ryan twisted the dial until he was again floating. "I can do this for a week on a couple of flashlight batteries."

The attorney mopped his brow. "It would really help if you could explain why you're not violating the law of conservation of energy."

That evening, Ryan asked Gleimickr.

AH, HYDROPOWER GENERATION, came the reply. PRIMITIVE, BUT EFFECTIVE. IF I HAD BEEN WISER, I WOULD HAVE SUGGESTED IT MYSELF. AS FOR YOUR QUESTION, NO, THE DEVICE DOES NOT VIOLATE FUNDAMENTAL LAWS OF PHYSICS. IT DOESN'T CREATE GRAVITY; IT MERELY REFLECTS IT. IF YOU REALLY WANT TO KNOW, THE ENERGY COMES FROM SUBDUCTING GRAVITONS INTO THE INTERSTITIAL MATRIX, BUT YOUR CULTURE'S INABILITY TO UNDERSTAND WHAT THAT MEANS IS ONE OF THE REASONS THESE NEGOTIATIONS HAVE TO BE CONDUCTED CLANDESTINELY.

His culture's lack of understanding also proved to be a major delay in making Ryan rich. But the fact that his device worked eventually carried the day, though it was three cyclocross seasons later before anyone but cyclists (famous

for their willingness to try anything, especially if packaged as an expensive gadget) actually gave him money.

Meanwhile, he continued to trade information with Gleimickr. By the time his antigravity device was earning royalties, Ryan was ready to launch his next money-maker: an internal-combustion engine that ran on water, made 325 miles per gallon, and emitted zero pollutants. This one was on the market within a year. Partly that was due to his success with antigravity. But it helped that there had always been rumors that the oil industry long knew of such technologies and had ruthlessly suppressed them.

Next came flying cars, which used an angled inverter field to tack against the Earth's gravity at speeds of hundreds of miles per hour. These were followed by a dozen other gadgets—some revolutionary, some just for fun. Nobody really understood how any of them worked, but it didn't matter because they always did. Nearly as good, it was usually possible to add a few whistles and bells for the luxury market.

By now, Ryan was accepted as humanity's greatest inventor since Edison (and maybe before). So when Gleimickr offered him the *pièce de résistance*—teleportation booths that allowed you to beam yourself anywhere on the planet, it was only a couple of years before roads were obsolete.

By this time, Ryan had a hilltop mansion with his own personal cyclocross course. Along with the mansion came a valet, cook, gardener, and a private transportation booth so that friends (especially of the more-discrete sex) could join him without becoming tabloid fodder.

But thanks to all of those amenities, Ryan had trouble finding the incentive to train for serious racing. Also, although he was still on the sunny side of the big four-oh, it wasn't by much, and despite increasingly urgent requests, Gleimickr

was more interested in selling him transportation devices than in providing remedies for slowing reflexes and a growing paunch.

Still, life was good. There was even talk of a big contract with NASA to see whether teleportation could be used to create a permanent Mars base (the next robot lander might carry a mini-booth for the first tests). Someday, Ryan hoped to be the first mountain biker on the Solar System's most gonzo downhill run: Olympus Mons. But there were plenty of details to be ironed out first, not the least of which was a life-support suit strong and flexible enough to do the job.

Partly from a sense of nostalgia and partly in the hope of learning something to bribe Gleimickr into giving him the secret of the Mars suit, Ryan continued watching at least thirty sitcoms per week.

One day, his vid center interrupted a particularly lame comedy with a "Special News Alert." That heralded a logo of a bright, blue star, surrounded by planets orbiting in fast-forward, like a swarm of gnats.

Simultaneously, his transport booth chimed, announcing an unexpected visitor. "Who is it?" Ryan said automatically. Having an unguarded transport booth in your house was an obviously unwise idea, so he had programmed his to compile the link only on his command.

But his primary attention was for the vidscreen, which now held a message in a familiar font.

PEOPLES OF EARTH, it read: PLEASE BE ADVISED THAT YOU HAVE BEEN OFFICIALLY ANNEXED TO THE PLANETARY SYSTEMS OF OUTER VEGA. RESISTANCE WILL LEAD ONLY TO REGRETTABLE DESTRUCTION. AS YOU READ THIS, OUTER VEGAN STORM TROOPERS ARE ENTERING BY TACHYON DEVICE EACH AND EVERY TRANSPORTATION BOOTH ON YOUR PLANET. DO NOT BE DECEIVED BY THE ABSENCE OF MORE THAN ONE TROOPER PER BOOTH: IN TOTAL, THERE ARE AS MANY TROOPERS AS BOOTHS, EACH CARRYING

WEAPONS AND ARMOR SUPERIOR TO THOSE OF YOUR MILITARY. IF YOU WISH TO LIVE, PLEASE FOLLOW THEIR INSTRUCTIONS WITH IMMEDIATE ALACRITY.

Reading the message, it never crossed Ryan's mind to doubt it. Rather, he felt a horrid sense of inevitability.

The trap in the old Nigerian Scam was the offer of riches for nothing. With Gleimickr's original letter, Ryan had been sure he'd spot the hook before it came, but instead, he'd fallen victim to his own sense of superiority. Then had come the flattering appeal to his "sensical commonality" and the fact that Gleimickr's devices had indeed made him rich.

All of that had blinded him to the fact that the hook had nothing to do with money. Instead, he'd happily built the aliens' gateway for invasion, even as he was dreaming of his own trip to Mars. *Guilty* might not yet describe his feelings, but *stupid* certainly did. Which, he supposed, was how it went with any scam.

Meanwhile, his transport booth was still chiming.

"ACTIVATE THE TRANSFER LINK NOW OR SUFFER THE CONSEQUENCES," a *basso profundo* voice rumbled through the speaker.

Ryan stalled. "And if I don't?"

"THEN THE NEAREST TROOPER WILL COME BY HOVERBELT AND ERADICATE YOU. YOU WOULD BE BETTER ADVISED TO DEAL WITH ME."

"And you're . . ."

"EXACTLY WHO YOU SUSPECT. VICE-ADMIRAL GLEIMICKR OF THE OUTER VEGAN INVASION CONSORTIUM. YOU CANNOT DEFEAT US, BUT PRESUMING THAT HUMANS CHOOSE TO SURVIVE, WE WILL APPRECIATE ASSISTANCE IN RUNNING THE PLANET. NOW, ACTIVATE THE TRANSFER LINK OR DIE."

Years of bicycle racing had made Ryan a pragmatist. If you're beaten, you can't waste time on what-ifs. Instead, you must do your best to salvage whatever is

still possible, whether it's second place or tenth. He wasn't sure what, if anything, was possible now, but thumbing his nose at a super-powerful alien wasn't going to gain him anything useful. "Okay," he said, and pushed the very low-tech (and therefore unhackable) button that completed the transfer.

Normally, a transfer is soundless: just a light puff from the displaced air molecules in the receiving chamber. This time, there was an actinic flash and the smell of fried electronics. Apparently, Earth technology hadn't permitted construction of a booth totally suitable for interstellar transport, though presumably the invasion force knew how to rectify that once they'd taken control. Or maybe tachyon transport always destroyed the receiver. Ryan's didn't exactly have vast experience with the process.

But when the smoke cleared, there was nothing inside. Wondering if Gleimickr might have moved so quickly that he was now standing behind him, Ryan spun, but found himself alone. Cautiously, he stepped closer to the booth, though there was nowhere for Gleimickr to hide. Was this all just a practical joke, after all? Not funny if it was, because it appeared to have done serious damage to his booth.

Then Ryan heard a tiny voice from somewhere in the booth's depths. "Oh, SNIKE," it said, or something that sounded like that. "WHAT THE FRAP ARE YOU?"

Ryan looked down. There, on the floor, stood a half-inch figure, covered in a bright-red carapace of something shiny. A helmet and visor obscured what was probably its head, and tiny, gun-like objects were clasped in its four arms.

Ryan took another step forward for a better look. "Gleimickr?"

"SNIKE, SNIKE, SNIKE!" said the figure. "YOU'RE A HELL OF A LOT BIGGER THAN THIRTY CHOLTUS!"

That took Ryan a moment to process, then he almost laughed. So that was why Gleimickr had been so interested in

getting feedback on his silly scaling factors. Apparently the transfer allowed him to alter his dimensions at will.

Ryan was suddenly very happy the booth's electronics were fried. Otherwise, Gleimickr might have been able to teleport back to where he came from and reappear at a more suitable size. Even so, he might still be dangerous. The Outer Vegans undoubtedly had good weapons.

Gleimickr apparently reached the same conclusion because now all four of his guns were firing at once, though the aim was a bit random. Evidently, panic—like trickery—was a species-crossing characteristic.

Ryan was a big enough target, though, that he was hard to miss. "Ouch," he said, as blaster fire pocked his skin. "That hurts."

Any moment now, Gleimickr was going to start shooting for his eyes, and that might do more than hurt. "Cut that out," Ryan said. But Gleimickr either wasn't listening or hadn't paid attention to Ryan's explanations of what cyclists do when winning is no longer possible, because he was showing no sign of applying them to himself.

Irritated, frustrated, but suddenly

feeling truly superior, Ryan moved forward . . .

. . . and stomped, hard.

He would later learn that all over the planet, other storm troopers met similar fates. Feet proved the deadliest weapon, although cats came in a close second. Apparently there was something about the storm troopers that they simply didn't like. Flyswatters and rolled-up newspapers also proved deadly, as did birds, for those who attempted to escape via antigravity.

Within a week, there were no more reports of weird red insects, or anything else out of the ordinary. The tabloids continued to scream about alien invasion, but that led everyone else to chalk up the ruined transport booths to a power surge and dismiss the TV broadcasts as a prank.

Meanwhile, Ryan got a pair of tweezers and began collecting alien equipment. Earth had survived one invasion by luck and miscommunication. If the Outer Vegans found a way to try again, the world's greatest inventor since Edison (and maybe before) intended to be much better prepared.

And who knows, maybe he'd also find a medkit with the cure to aging. ■

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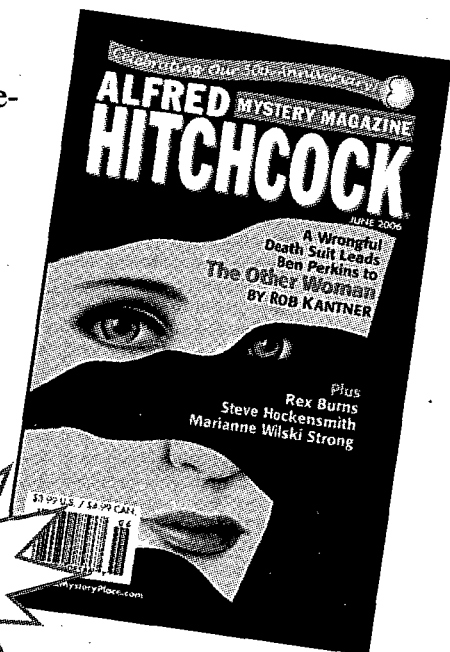
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From Wayfield, From Malagasy

by Robert J. Howe

Every culture has its own ideas of
"human nature." When the differences
become a matter of life and death. . . .



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Wayfield stood in the torrential rain, trying to wall off his feelings of despondency behind a professionally somber expression. He didn't think he was making a very good job of it. One of his officers read the traditional verse for the departed souls of Greene, Durban, and Mansourian, committing them forever to deep space. Though the ship had grounded, the verse was fitting, since the crewmembers' bones would be forever entombed in the lethally radioactive hull of the *Malagasy*.

He hadn't lost a crewmember in twenty-nine years of spacegoing, including several gunfights—one that holed his ship's hull. Now he was burying three of his crew in one miserable day. The rescue service's unofficial motto was "you have to go out, you don't have to come back." It was one thing to lose crewmembers to a rescue mission, though, and another to lose them to a reactor accident. He felt like a failure for allowing three deaths under his command, and more of a failure for not being able to manage the kind of detachment required of a commanding officer.

Though there was much to be done before sunset, the crew needed a few minutes to catch their wind, literally and figuratively. In addition to the deaths of three shipmates, the space-weak crew was wrung out from the mad scramble to offload everything portable that wasn't contaminated with radiation.

While the crew stood at attention for a moment of silence, Wayfield's eye wandered over the heaps of gear hurriedly salvaged from the ship, calculating their short-term needs for survival. He hoped they wouldn't end up missing the twenty-one rounds the honor guard used to salute their dead shipmates.

He worried whether the Unmanned Communication Vehicles made their jumps intact, and if their beacons would be picked up. He hoped his wife and daughter wouldn't find out that *Malagasy* was declared overdue and have to

endure a long, tense search. Luba was a service wife—she would probably handle it well enough—but Lydia had never gotten used to his long patrols, and even as a young woman still got weepy when he left for the port. It would break her heart if they weren't recovered soon.

Wayfield was yanked abruptly from these maudlin thoughts by calls from the sentries posted at the far edge of the field. The crew stared as one in the direction of the treeline, straining to hear the sentries' words over the din of the heavy downpour.

Petty Officer Soyombo came splashing back toward the group, his weapon at port arms, groundside weather gear streaming water. He pulled up breathlessly in front of Wayfield and the others. Though tall and thin like a runner, Soyombo hadn't had the chance to jog ten meters since he'd come aboard the ship, nor were his muscles used to planetary gravity.

"Skipper, there's people coming up from that village," he gasped out. "Three or four of them."

"Humans?" Commander Nylund, *Malagasy's* executive officer, asked.

"Yes, ma'am, appeared to be. Mixon is watching them," Soyombo said. "They're coming right along," he added anxiously.

Wayfield looked at his executive officer. "Okay, XO, get ship's company deployed in a perimeter. Make sure all the weapons are safed."

Nylund nodded and turned to the division heads, who'd already heard the captain. "Jan," she said to the operations officer, "put your people along the tree-line." She turned to Lieutenant French, the engineering officer. "Put yours about halfway back to the ship."

As the officers got their crewmembers disposed, Nylund raised her voice to a bellow to address the entire ship's company.

"All right," she shouted, "weapons on

safe and pointed at the ground. Watch your officers for their lead."

They all looked nervous, Wayfield thought. Only a very few of the veterans had ever been in a fight, and none had ever made first contact. Still, they carried out their orders steadily enough, especially for a crew that had just survived a ditching and the deaths of three shipmates.

By the time the crew was spread out in defensive positions, Petty Officer Mixon walked out of the treeline followed by the three natives.

The three men were all tall, dark-haired, and bearded. They were apparently trying to talk to Mixon, who was ignoring them and heading straight for Wayfield and Nylund. Wayfield noticed that the two petty officers guarding them held their weapons with white knuckles.

"Easy does it," Wayfield said in an undertone to the nervous guards. "Nobody's going to get hurt today."

From their similar height, rusty complexion, and features, the natives could be brothers. Their clothes were slightly unusual—jumper-like tops and close-fitting trousers—and the weave of the garments was a bit loose and uneven, but nothing that would have gotten a second look in any cosmopolitan port. None carried anything that looked like a weapon, though they could well have them concealed under their clothes.

The natives continued to try to talk to Mixon once he stopped in front of Wayfield. After Mixon shook his head vehemently and pointed at the captain, one of the trio—distinguished by a missing patch of beard where his chin looked scarred—turned to Wayfield and appeared to pick up the conversation where he'd left off with the sailor.

The natives' language wasn't remotely familiar to Wayfield, and he'd heard a lot of strange tongues in his years of service. He motioned over Carde, the ops officer, who'd recently been through Boarding Officer School.

"You recognize this language, Jan?" he asked.

"It's an outworld dialect of some kind, Captain," Carde said. "I think . . ."

The native who'd been addressing Wayfield looked from him to Carde and back, then said in passably accented Standard, "It's an outworld dialect of some kind, Captain."

Most of the crew was already at their stations when general quarters sounded on the SGC *Malagasy*: the delta-vee alarm always brought curious off-watch personnel to the pilothouse and engineering control room.

PT3 Mansourian, on throttle watch, was the first to notice the radiation leak, and the first to die. Because of a design flaw in the ventilation system, there were some dead spots in the air circulation, and the steady ooze of highly radioactive coolant hadn't reached any sensors to trigger an alarm. Mansourian used the IC to tell the engineering officer of the watch about the leak.

On the bridge, Wayfield didn't know how widespread the leak was, but he had to assume the worst.

"What's the nearest jump point?"

"Captain, the nearest loop takes us further from a known system; so does the *next* closest," the watch officer said.

With Wayfield looking over his shoulder at the nav screen, the officer found a jump to a charted solar system with a habitable planet, though one without a port, or even a full descriptor in the files. A G-type star, with one E-type planet, noted in passing by a survey ship, but only sampled from orbit. "Probably no ILL," the surveyor had written: no indigenous, intelligent life. As if they could tell from a few orbital passes.

The jump was nineteen hours away at maximum sustainable acceleration—weeks closer than their destination port, and almost two months closer than their point of departure. Not knowing how long he'd have reactor power, Wayfield ordered a course to the newly surveyed

solar system at two-thirds MSA.

Once *Malagasy* was underway toward the jump point, Wayfield ordered its three UVCs launched: two for the jump back to the ship's point of departure and a third for the jump to their original destination.

From where they were, sending a radio message though straightspace was useless. It would take thousands of years to arrive at the first habitable outpost, much less one that could launch a rescue effort. The UCVs were programmed to send a Mayday once they reached the far side of their respective jumps, continuously broadcasting *Malagasy's* situation report, intended touchdown, and course and speed information.

If the UCVs worked, their chances were fair that another ship would raise the beacon, but the version *Malagasy* carried was being phased out of the fleet because of intermittent jump failures. The vehicle would run up to the hole, then the logic circuit would fail to pull the trigger, and the UCV would sail on uselessly in straightspace forever.

Whether a rescue could be mounted before they ran out of food, or succumbed to disease or hostile fauna, was an open question. Some uncatalogued planets had Earth-normal strains of flora and fauna, seeded during successive pulses of human expansion through loop-space, but that also increased the possibility of lethal indigenous microbes.

The landing itself would be the moment of maximum danger, when the thrust required to settle the ship gently on the ground would call for considerable power. Everything that could be quickly offloaded from the ship had been stacked in orderly piles along the passageways that served the cargo elevator, with foodstuffs and the most critical gear—weapons, Field Nanodox, and ground weather clothing—preloaded into the elevator.

The leak worsened on the run-up to

the jump. When the ship adopted its stern-down attitude for landing, radioactive coolant was going to pool on the aft bulkhead of the reactor space, what would be the overhead of the control room. The gastight bulkhead would prevent any leakage, but depending on how much coolant ran off the reactor during descent, it could give off a lethal dose of radiation to the operators standing in the compartment just below.

It was how they lost Greene, and Durban, who went in to get him.

Wayfield was immensely relieved when the cutter dropped into straight-space and found the planet right where it was supposed to be. They made two passes to survey the planet for a drop site. On the second, Carde called him over to the IR display of the ground-track.

The ops officer pointed out a cluster of red hotspots near a cooler blue band. "Skipper, I make those cooking fires along a stream," he said. "And these," he pointed to a series of warm yellow blobs around the hotspots, "I make people—almost certainly humanoid by body temperature and conformation."

No indigenous, intelligent life, my ass, Wayfield thought. "Very well," he said. "That's where we'll drop the ladders."

When the native mimicked Carde's words in Standard, his two companions stopped trying to talk to the other crewmembers and gave Carde their undivided attention. Likewise, all the hushed talk among the crew stopped immediately. Carde pointed to the captain, the XO, and himself in turn, and said their names and ranks.

The native with the bald patch on his chin appeared to understand immediately. He repeated the names, nodding to each of them, then pointed at himself and said, "Boget." He then pointed to the other natives and said names that sounded to Wayfield like "Plensow" and "Garr." He then waved to indicate all of the crew and pointed at the grounded

Malagasy, then pointed up into the streaming sky.

It was an intimidating display of composure and intelligence, Wayfield thought. Strange people had apparently come from the sky in an unfamiliar object, yet the native had immediately inferred those facts and seemed unfazed by them.

"Yes," Carde said, nodding his head. He indicated the crew and the cutter. "We are off the ship."

Boget said "Ship," and started walking toward it.

"No!" Carde had to take two steps to get in front of the native. "Radiation—dangerous!" he said.

Boget stopped short and looked surprised. He pointed at his eye and at the ship, then made to step past Carde. His meaning was clear: *I want to get a closer look.*

The armed crewmen held their weapons self-consciously, not sure if they should intervene. Wayfield shook his head and made a palm-down motion to them.

Carde yelled "No! Wait!" and again stepped in front of the native, who was now plainly annoyed. Carde looked around, obviously trying to think of a way to explain the invisible threat of radiation without provoking the man. He bent over and picked up a fist-sized rock.

"Look" he said, pointing at the native, then at himself. Carde pantomimed hitting himself with the rock while grimacing theatrically.

"Bad," he said, "Dangerous!"

Boget looked blank.

Carde repeated the action, saying "Dangerous!" emphatically. Then he pointed at the ship again: "*Dangerous!*"

The native looked at Carde, then at *Malagasy*. "Ship dangerous," he said.

"Yes, yes!" Carde said, nodding extravagantly. "Dangerous, bad."

Once again, Wayfield was struck by the native's quick grasp. Boget wasn't just mimicking Standard. Given even the

slightest context he understood the language almost as fast as he heard it.

All of this was taking place in a cold, drenching rain. Even wearing ground-side weather gear, the crew was suffering from the wet and the five-degree temperature. Who knew what bugs this planet had? The weaker the crew's resistance—already compromised by stress—the more likely they'd sicken. *Malagasy's* single medical corpsman, Durban, lay entombed in the dead hull.

"Lieutenant, ask him about shelter," Wayfield said. Carde seemed to be doing well with Boget, and Wayfield didn't want to muddy the waters.

Carde launched into the question, mostly through pantomime. The native seemed to grasp the idea of shelter, or at least protection from the rain, quickly enough, but the officer couldn't get across the need to get the crew out of the weather.

Carde turned to him. "Captain, why don't a few of us go back to the village with them?"

Wayfield hesitated for a moment. This was a tough call. They hadn't long until nightfall. Would the temperature drop below freezing at night? It seemed possible. On the other hand, they'd set the ship down less than a kilometer from the native settlement.

Finally he said, "Okay, Lieutenant, good idea. Have Soyombo and a couple others go with you, and make sure you have lights. You should start back in, say, two hours."

Wayfield wasn't happy about having his ops officer go off with a lightly-armed party, but they needed information, and there was too much work to be done getting the salvaged gear sorted out to mount a larger exploration party.

"XO, let's get as much of the salvage under cover as we can," he said. "Get them started on some kind of shelter, and get at least one fire going." He gestured to the treeline. "There must be some standing wood dry enough to

burn, even in this downpour."

"Most of the food and weather-sensitive gear is under tarps, so we're okay there," Nylund said. "Once we get a cover overhead, I'm going to start resting them in sections."

Wayfield assented, and Nylund went off to organize the crew, shoulders slumped with fatigue. Like many of the crew, she hadn't slept much since the reactor emergency began. Despite logging more than the required hours on the shipboard exercisers—he was a stickler for that—the planetary gravity was wearing them all down rapidly.

Watching the crew gamely get to work in the cold and wet, he tried to suppress his own exhaustion and the creeping defeatism that came with it. Despite the fatalities, things weren't as bad as they could be. If the natives could scratch out a living here, his crew could probably survive long enough to be rescued.

Carde, Soyombo and Mixon were back before the crew had made much progress on a shelter.

"The village is just on the other side of the river," Carde said, "less than a kilometer."

"How many people?" Nylund asked.

"Many more than us—maybe a few hundred or so," Carde said. "It's a bit hard to tell. It looks like every adult has his own little house. The village is laid out along the bank for a ways upstream, but it only extends back from the river a hundred meters or so."

Carde glanced over at the group of crewmembers working to gather materials for a shelter. "Some of the houses—they're like huts, really—have these big flat leaves on top, like roofing shingles. The trees grow along the river bottoms. Soyombo can show the rest of the crew."

The XO nodded, and Soyombo and Mixon trudged off to join the working party, their weapons slung upside down on their back to keep the everlasting

rain out of the muzzles.

Carde turned back to Wayfield. "I think we pissed off some of the locals while we were looking around, Captain," he said. "There was a kind of cooking frame outside one of the little huts. It looked like metal, and Mixon picked it up to check it out. All of the natives looked at Mix like he slapped them. He put the thing down fast, but they still looked unhappy."

"Was the thing made of metal?" French wanted to know.

"Mix says no," Carde said. "Some kind of wood, probably hardened by fire."

"Anyway," he went on, "We tried talking for a bit more, but there didn't seem much point in it. There aren't any structures big enough to house more than one or two people at a time. Boget showed us his little house—windows but no glass, rough plank roof and floor, but dry inside with tight joints. There was some wood furniture inside, a bed, table and stools, and some boxes, but we didn't touch anything, and I didn't see any tools or metal."

Wayfield nodded. "Food?" he asked.

"They didn't offer any, but we saw some local plants in the houses," Carde said. "The big thing is that they have domestic cattle, Skipper. Shitloads of them west of the river. When you get close to the village you can smell meat cooking."

The size of the settlement and the cattle were a good sign, Wayfield thought. Of course there was no way of testing whether the genetics were compatible, except with their stomachs. For the thousandth time that day he wished for more survey equipment, or at least access to *Malagasy's* libraries.

"One thing that struck me as odd," Carde said. "They were looking at our gear the whole time, especially the metal and synthetics, but they never tried to touch anything, even to feel the texture. They never even gestured as if they wanted to hold anything."

Wayfield chewed this over. He was never a survey officer, but he'd touched

down in some exotic places, including a handful of first- or re-contacts. Local manners varied widely, but he'd never seen any culture that wasn't wildly interested in any new technology, from portable reactors to mill-woven fabric. Some humanoid cultures would enthusiastically strip unarmed crewmembers naked to sample their gear.

"Okay, that might have been in response to you stopping them from approaching the ship," Wayfield said. "We don't have much to go on. Don't worry about their reaction to Mixon. This was a pretty successful contact. Good job."

The natives were not overtly hostile, at least, and if it came to that, the ship's company appeared to have the upper hand in weapons. For the moment, the main job was still getting his crew sheltered and warm.

The rain tapered off by nightfall of the first day. The sun rose hot and white the next morning, and by midday the temperature in the shade was just over thirty degrees. The only work Wayfield allowed was the spreading out to dry of wet gear and clothing, and gathering of more firewood. The shelter they'd erected the first day was inadequate, but he gambled the good weather would hold at least one more day against the certain advantages of letting the crew bake in the hot sun and sleep themselves out.

Nylund charged two quartermasters with marking the times of sunrise, apparent noon and sunset. A local day was 39.7 standard hours, or about 1.7 Sols. That was close to the survey crew's guesstimate. The length of day and night appeared equal. That could mean they'd just happened to arrive at an equinox, or that the planet had a very long year, or a very small tilt of its axis relative to the elliptic plane, or some combination of the three.

Boget and another native, one they'd not seen before, returned to the landing field on the second day, and Wayfield had the word passed to the ship's com-

pany that no one was to pick up or touch anything of local manufacture, or that appeared to belong to the natives.

Boget spent most of his time with Carde. The other native stalked around looking at all the gear spread out to dry, observing the "look but don't touch" rule Carde had inferred from his trip to the village. Once they'd eyeballed all the gear, Boget's companion became visibly bored, and the natives left.

The fine weather held, and no one appeared to sicken despite exposure to the new planet and natives of uncertain genotype. A few crewmembers were mildly sunburned from sleeping in the open, but otherwise the ship's company was healthy and was adapting to planetary gravity.

The natives were obviously of ancestral stock, but Wayfield didn't have access to a DNA lab to know whether speciation had taken place. Of course, the answer to *that* question would be solved the old-fashioned way if they stayed on the planet long enough: sooner or later his crew would interbreed, or try to, with the native population.

Likewise, they didn't know whether the flora and fauna were ancestral, exotic, or some combination of the two. This had the most dire implications for their mid- to long-term survival. With no way to preserve their deep-frozen foodstuffs, the ship's stores would run out in a few standard weeks. It seemed likely that if the human genotype was here, ancestral plants and animals had to be as well. But it was entirely possible that the native population and its food chain had evolved far enough from the baseline to render the local menu inedible for Wayfield's crew.

It took an astonishingly short time for the crew and the natives to start conversing in a pidgin tongue that was mostly Standard, except for words to describe local geography. Carde tried to learn the local tongue. The natives weren't so much uncooperative as overwhelming in

their enthusiasm for Standard.

Each evening the officers met in the "wardroom," a crude, three-sided shack with a leafed roof. Among other things, the nightly meeting generated the ever-expanding list of questions they needed to ask the natives.

Carde was frustrated to report that he had not heard ten words of local dialect all day.

"I point at something and I say the Standard word for it, and they all nod appreciatively and repeat it after me," Carde said. "It's like I'm their language tutor."

French arrived at the meeting with Petty Officer Soyombo in tow. "Skipper, I think you ought to hear what Nal thinks about the natives' language abilities," he said.

"Yes?" Wayfield said. "What's on your mind, Soyombo?"

The sailor was clearly ill at ease addressing the officers. "Sir, it's NLP, I think," he began. "I read about it in a journal in the library."

"What is, petty officer?" Nylund said, a little too sharply.

"Why the natives can pick up Standard so fast, ma'am," Soyombo said. "NLP is Neotenic Linguistic Plasticity. You know babies can learn a language faster than adults? NLP is a mutation of the Fox2P site; adults that have it can acquire new languages organically, the same way babies do." He turned to Wayfield, "That's what 'neotenic' means, Captain; the retention of juvenile traits or characteristics in adults of a species."

Wayfield had to suppress a smile at the easy way the technical terms rolled off the sailor's tongue. "Where did you learn this, Soyombo?" he asked.

"In the *Journal of Biological Anthropology*, Captain. In the ship's library."

Malagasy carried the Standard II Library in her computers. Its 2.6 billion volumes didn't match the really big libraries the research boats had, but it covered a fair number of disciplines in some depth. Wayfield knew that on long

patrols so-called Great Books reading clubs would sometimes spring up among the crew, but most sailors confined themselves to popular entertainment and novels (under his predecessor, books and entertainments about penal colonies were apparently quite popular). Of the many things he wished they could have salvaged from the ship, the library was near the top of the list.

"Were you reading this for a course?" he asked.

"No, sir. Just for fun," Soyombo said. "I read a lot."

"Anything else you can recall about this NLP?" Carde asked.

"Uh, let's see," he said. "It's rare, mostly confined to homogeneous out-world populations—that's what made me think of it, sir, the homogeneity. I think that's all. I read the article a long time ago," he finished apologetically.

"Soyombo, that was excellent work," Wayfield said. "If anything else occurs to you from your reading, don't hesitate to bring it to Mr. French—even if you think it's not important."

"Yes, sir," Soyombo said, beaming.

"Okay, well done, sailor," Wayfield said.

Soyombo saluted and left, making the officers smile. Outside of musters and ceremonies, saluting was a courtesy rare among cutter crews.

"He reads biology journals just for fun," Carde said, shaking his head.

"Yeah, smart kid," French said. "He couldn't get into a research rating because he took a short contract, so he's watching screens and cleaning the control room for me, instead. He's going back to school when he gets out."

"Again I remind everyone to mind what you say around the natives," Wayfield said. "They're soaking up everything we say. And pass the word again among the crew. Boget already knows a few more anatomical references than he needs to."

The officers laughed. The natives treated new words like shiny souvenirs

and would sometimes come out with crass sailor expressions unexpectedly.

The most worrisome pattern that emerged, however, was that every attempt to trade, even trivial items, was stolidly rebuffed by the natives. When a crewmember looked at an item of local manufacture, the native it belonged to might offer it to them for inspection, but if the crewman dawdled with the artifact too long, or tried to move away with it, the native would physically take it back. Likewise, when offered crewmembers' gear for inspection, the natives would handle and inspect the item enthusiastically, then quickly hand it back to its owner.

"If you show the least interest in learning, they'll try to teach you how to make anything," Carde said. "They'll spend hours doing it. But they get very agitated if you try to take any little thing, even a flake of worked stone."

"Well, we're not going to force the issue yet," Wayfield said. "But we need to try and find something they'll trade for. Maybe water cans? It's got to be hard to make cans or buckets from local materials. Plastic would be better for storing cow's milk . . ."

"They don't drink the milk, Skipper, or make cheese or butter," Carde said. "Apparently it gives you bad, bad diarrhea."

"Could they be gut-intolerant?" Ny-lund said. "A genetic thing, like the language?"

French shrugged. "It's possible, XO, but the milk could also be full of bacteria," he said. "I'd hate to experiment with it, unless we were in a really tight squeeze, food-wise."

"Well, there's a lot of other options we need to explore first," Wayfield said. "Let's hope it doesn't come to that."

The real trouble began as soon as the natives learned enough Standard to move beyond simple descriptions of objects. Boget pointed at Wayfield's uniform coverall and asked, "Who is that

from?"

Wayfield was stymied. He looked at Carde, who was ahead of everyone on understanding the natives' pidgin Standard, but the Lieutenant just raised his palms in a "who knows?" gesture.

"From?" Wayfield repeated. "Who gave it to me?"

Now Boget looked puzzled. He turned to Carde. "What is *gave*?"

Carde took a wetpen from the pocket of his coverall and handed it to the native. "I gave you the pen," he said. When Boget still looked puzzled, Carde picked up a stone and handed it to Wayfield.

"I gave the captain the rock," he said, pantomiming the giving motion while he said "gave."

The native considered this for a moment, then appeared to dismiss his thoughts with a shake of the head, a gesture he'd picked up from the crew. He handed the pen back to Carde.

"No, who taught Wayfield to *made* the clothes," Boget said carefully, pointing to the captain's garment.

"Ah," Wayfield said. "I didn't make—made—the clothes," he said to Boget. "It was made on . . . In another place, by somebody else. I don't know who."

Boget looked at Wayfield, then at Carde, obviously confused. "Another person *made* the clothes?" he said, going as far as taking a fold of fabric between his fingers to make the point.

"Yes," Wayfield said. "Another person made this. Why?"

Boget looked at Carde's coverall. "Who is that from?"

Carde and Wayfield exchanged slightly troubled glances; from the native's tone he was obviously upset.

"I didn't make this," Carde said. "It was made in another place, by other people. That's their work, to make the clothes." He didn't go into the idea of factories, or the likelihood that the garments were made entirely by machines, which were made by other machines, which were made by still other machines. Somewhere up the chain was an-

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other person or persons, and that was clearly the sense of Boget's question.

Boget pointed at a water can. "Who made that?"

"Another person, back home," Carde said.

Boget pointed at *Malagasy*, shut off behind an impromptu safety barrier. "Who made the ship?"

"Many people," Wayfield said, "Not people here; people back in another place."

This was apparently too much for Boget, who stared incredulously at Wayfield for a moment, then turned on his heel and headed for the river.

"Could they really think we *made* all this stuff?" Nylund said.

"They make all of their own tools and implements and whatnot," Carde said. "As unimaginable as it is to us to build a starship—or even a water can—I guess they assumed we did, too."

"I think our friend there just got the impression that we're idiots," Wayfield said. "Is it possible they don't use anything they can't make themselves?"

"Explains their low level of technology, compared to their linguistic sophistication," Nylund said. "And why they get upset if we pick up any of their gear, even just to move it out of the way."

Wayfield nodded. "The reality is that we need them more than they need us," he said. "This just underscores it. Let's hope Boget gets over his mad, and doesn't get the others turned against us."

Without the natives' help, the crew—by and large technical people who'd never lived on a world where anyone actually grew or hunted their own food—would have to learn which plants were edible and which game could be hunted, to feed themselves when the ship's stores ran out. So far, no one had seen any large game. There were birds aplenty, shy nocturnal mammals that lived in the trees, and a ubiquitous small lizard, but no one knew if their protein was digestible. For that matter, they didn't

know whether the cattle were edible, either.

They would have to start sampling the local produce in small amounts, Wayfield decided. And they'd have to try capturing larger game, if any existed—he hoped their absence locally was merely due to the presence of the natives and their domestic grazers.

Wayfield had read too many accounts of first colonies that had starved or frozen to death or succumbed to disease between resupplies. In most ways the crew of *Malagasy* had less experience and fewer implements with which to make a living.

French turned out to have an aptitude for hunting. Normally a taciturn man who tended to dampen conversations with his long face, he was grinning from ear to ear when he came back into camp with a small antelope slung over his shoulders. Even Boget seemed impressed. He said the antelope were tasty, but rare.

Wayfield allowed only three volunteers to try small portions of the antelope meat. After the three crewmembers seemed to suffer no ill effects, he allowed the rest of the butchered animal to be cooked and distributed as fairly as possible. Wayfield took a few bites of the game, which was dense and strongly flavored, but palatable.

Whether the crew could get nutrition from the exotic game, and whether it harbored any parasites that might not be destroyed by cooking, would only be answered in time.

Boget gestured to the chronometer Wayfield was recalibrating to the local day. "How can you say this is yours, if you did not make it?" he wanted to know.

As always with an alien culture, it was hard to judge the depth of explanation suited to the question. The chronometer didn't belong to Wayfield personally, of course—it was property of the ser-

vice—but that didn't get to the heart of what Boget was asking.

"I did not make this," he said, "but I did things for other people, who gave me this in return. A 'trade.' I know Lieutenant Carde has told you about trades."

"Why would you not learn to make the thing yourself?" Boget asked. "It makes you like a child to use things without understanding them. What will happen if this thing breaks?"

It was a shrewd question, and from Boget's point of view, absolutely correct. In a non-industrial society, depending upon technology you couldn't make or repair yourself was a recipe for disaster in the long term. Wayfield hoped they'd be rescued in the short term, but *hope* wasn't a plan. Of course the natives here took self-sufficiency to ridiculous extremes, he was beginning to realize. They passed up tremendous rewards in time, labor, and material well-being by not cooperating on tasks, even within families.

"We want to learn how to make things, as you know," he said. "But this chronometer takes more tools . . ." How to explain infrastructure? "It's not possible to do it with what we have here. It would take many, many years for one of us to make anything even a little like this."

"I understand this, okay," Boget said. "But this is not from Mesurda," he said, using the native name for the planet. "It is not for you to just pick up from the ground. Why do you use it? Aren't you . . ." he groped for the Standard word. "Aren't you *shamed*? Is that right?"

"Yes, shamed, ashamed—that is right," Wayfield said. He wondered from what context Boget had picked up *that* word. "For us there is no shame in it. I cannot make this, but I can do many other things. The people who can make this cannot do many of the things that I can do, so we make a trade."

As always Boget listened carefully to the explanation, though his expression

remained troubled. When Wayfield was finished, the native thought for a moment, then gave a dismissive headshake. "I understand what you say," he finally replied, "but I don't think it is right."

Most of the crew was assigned to do little but learn the local technology. As stinting as the natives were with their belongings—even husbands and wives, if that term meant anything here, didn't share households, or food, or implements—they were incredibly patient and generous in teaching anyone. And they were always disappointed when the crew had so little to teach them in return.

The weather closed in again, much more fiercely than on the day they ditched. Driving rain and high winds stripped part of the roofing from the main shelter. The crew's misery was partly alleviated by roaring fires, but the storm set back their efforts to learn local skills.

In bad weather, the natives holed up in their huts. They didn't visit one another's little houses, nor cross the river to the camp.

When the weather blew out Wayfield hoped to make up time in getting a handle on the natives, but the next conversation with Boget was in the familiar, frustrating rut. Wayfield started the conversation asking about the cattle. Was there something the crew could trade for a few heads?

Boget dismissed the question tersely. "We don't have want for the things we can't make," he said.

"Could you *give* us one animal?" Wayfield asked. Establishing the precedent might be more important than the amount of food he negotiated.

"Are you children?" Boget asked scornfully. Before Wayfield could reframe the question, the native gestured to a simply made box for spare electronics and asked, "Who is this from?"

It was as if, by asking the same ques-

tion about each item that caught his eye, the native hoped he would stumble across one thing that someone aboard *Malagasy* had actually crafted himself.

"No one here made that," Wayfield said.

As usual, Boget looked pained. He shook his head nervously. "Is there *anything* you can make yourself?" he finally blurted out, looking highly agitated.

From what he knew of the culture, and from the native's demeanor, Wayfield imagined that this would be a highly provocative question among his own kind. Yet he sensed Boget was genuinely trying to understand him and his inept shipmates.

"The others look to you like children do," Boget said, while Wayfield was still groping for a satisfactory answer to the question. "What can you make that they cannot?"

"Decisions," Wayfield said without thinking about it. "I make decisions for them. For the ship. I'm their leader, like you are the leader of your people."

Boget seemed to consider this. "Leader?"

"Yes, like you, I tell the others what to do . . ."

He stopped because Boget was looking at him open-mouthed. "I don't tell my brothers and sisters to do *anything*," he said emphatically.

"Who makes the decisions that affect the group?" Wakefield asked, again having the frustrating sense that he'd wandered out onto thin ice.

"I am only Boget," the native said. "I think about . . . about how to live." Boget seemed to struggle with translating the concept. "Then I talk about it. That is all. The others are no children. No one should tell them what to do."

Wayfield had an idea. "Are you a theist? A priest?"

Boget looked at him blankly.

"Do you believe in a god?" Wayfield asked, pointing at the sky. "A spirit?"

Boget looked up, then back at Wayfield, his expression still blank.

"What is a spirit?" Boget said. "Do you have it here?"

Wayfield's heart sank. Now he was condemned to a long, convoluted explanation of an abstract concept, at the end of which Boget would once again be incredulous and disappointed. This was a conversation he needed to have with Carde present.

"No, it's not . . . I can't show it to you," he said. "Tomorrow I will tell you about it."

Boget appeared very reluctant to relinquish the conversation, but after a minute he nodded and waved goodbye, another mannerism learned from the crew.

Wayfield watched him go. What struck him about Boget's curiosity is why it wasn't shared by more of the natives. Only a small handful sought out the crew, even though many of them spoke Standard passably well. They would talk to crewmembers if approached, and were unfailingly generous in instructing them in local crafts, but seemed otherwise uninterested in the strangers who'd landed in their midst.

His low mood made him think about Luba and his daughter waiting back home for news of *Malagasy*. He shook himself—no good going down that road. Work was the anodyne, especially stranded here with no other diversions. What should be the next step?

Wayfield took Carde to visit the native village. Along the way he filled Carde in on his abortive conversation with Boget about theism.

"I don't think they have the concept, Skipper," Carde said. "They bury their dead to keep them from stinking up the place, but they don't seem to believe the dead somehow continue on. I think Boget is just uncharacteristically curious. Uncharacteristically for them, I mean."

Wayfield digested this as they walked along the length of the village. There were no doors on the huts, just flimsy

privacy panels that could be pushed aside with one hand. None of the natives would dream of touching another person's property, even to move it out of the way.

As usual, the officers spent more time explaining themselves to the natives than the reverse. If information was currency, the natives enjoyed a five-to-one exchange rate in their favor, enforced by sheer mulishness.

Boget was off the word "spirit," thankfully, but wanted to know what a "mission" was, having apparently overheard Nylund use the word to one of the crew. Of course the word had no local analog, since it involved acting on behalf of others and following orders. By using the example of hunting to feed a child, Wayfield and Carde thought they had more or less made their point. Then Boget asked what was Wayfield's *mission*?

"To get my crew back alive," he said. "Which is why we need to talk about the cattle."

Back where? Boget wanted to know, ignoring Wayfield's negotiating sally.

"Back to—" Wayfield almost said *civilized* space. "Back to where we came from."

Boget then asked Carde the same question.

"The captain's mission is my mission. I take my orders from him."

"How will you do this *mission*?" Boget asked.

"I will keep the crew alive until another ship comes to get us."

Boget shook his head, a familiar gesture of scorn and puzzlement over these people who depended on the help of others. He said goodbye and headed back to his little house.

"That didn't get us very far," Wayfield said, watching the native go.

"It's eerie, Skipper," Carde said. "When the children reach maturity they're given their share of cattle and that's it. Nothing else. They have to build their own houses—I think most of them start building their first house be-

fore they're seventeen, but that's why the younger people mostly have the worst houses."

"How do they maintain a population?" Wayfield asked. "What happens when they get sick?"

"I gather they die," Carde said. "It's not a subject they're very interested in talking about."

That was cheery, he thought. "How are we on food?"

Carde grimaced. "Not so good. Even at half rations, we probably won't go another forty days before we're out altogether."

French's luck with the antelope hadn't been repeated. There wasn't any large game within walking distance of the camp. The crew's muscles were adapting more and more to local gravity, which meant they needed to consume more calories just to maintain normal weight.

The small game around the camp was inedible; the lizards were actually toxic, which is probably why they were so abundant close to the native village. The natives ate none of the lizards or birds around the village. Only the animals that colonized the planet concurrently with the natives—the cattle and antelope—were fit for human consumption, it seemed.

Carde had sampled the cattle flesh, to no ill effect, by the simple expedient of borrowing a bone set aside for tool making and gnawing off the remaining raw meat. The grasses upon which the cattle grazed and some edible plants had obviously been established in an earlier pulse, but they hadn't yet crowded out all the indigenous fauna, or the biomass it supported.

They were quickly learning the hard facts of pre-industrial economics. The work expended to find game and bring it back to camp couldn't be greater than the caloric value of the meat itself, and in fact had to be significantly lower than the break-even point to justify the hazards of sending out hunting parties.

The natives and their cattle seemed to have killed or displaced all the antelope, which were said to be abundant elsewhere. It was a mistake, Wayfield realized, to ground the ship close to the village. Had they landed somewhere in the wilderness, near another body of fresh water, they might have found a high enough concentration of antelope to support the crew until rescue.

By the time they returned to camp, Wayfield was worn out from the walk, and from wrestling with problems that seemed to have no solution.

"Population size is tied to the cattle herds, I'm guessing," Nylund said. "We can't even get them to trade away a stone tool; I can't imagine that they'll part with a head of cattle under any circumstances."

Unless something changed, the crew was going to starve to death before they could be rescued. Wayfield didn't know what would happen if they tried taking food from the natives by force. The crew was outnumbered almost eleven to one, but the natives only had stone and wood hunting weapons, and a few tools that would be lethal in close quarters. That might be enough if they attacked the crew all at once. There were six sidearms and fifteen assault weapons in the armory, with thousands of rounds for the rifles and a few hundred rounds for the pistols, in addition to some non-lethal munitions. Small arms were the one area in which the fleet's lag in modernization gave the crew an advantage. If they'd been equipped with magnetic rifles like the newer research boats, they would have been dependent upon batteries that couldn't be recharged without a reactor. As it was, given a small amount of warning, they'd be able to defend themselves. Probably.

How many natives was he going to have to kill to save his crew? Even though the natives' obdurate unwillingness to share resources, or even trade for them, angered Wayfield and put his

crew at risk, he didn't want to kill any of them. And in the back of his mind was the possibility that he might face charges once they were rescued. Worse, his officers might face charges, too.

He had to decide before they were completely out of food. The crew had to be strong enough to fight, if it came to that.

He sent for Nylund, Carde, and French. "Let's take a walk," he said. He didn't want to have this conversation in earshot of the crew or the natives.

They headed for "Red Hill," named for the other rocks on its flanks. It took a half hour to reach the summit, and all of them except Carde were panting with exertion by the time they reached the top.

Wayfield took in the view while they let their breathing return to normal. It was just past local noon, and the river was a beautiful silver ribbon between lush green banks. The sun was warm. But not oppressively so, and the small peak caught a good breeze from the west.

When everyone was breathing normally again, he spoke for a few minutes, laying out his general plan.

They had two choices: they could leave the landing site and try to find a location with more game, or they could make the natives give up some cattle by force.

The former course seemed a poor option. If they expended their meager rations on a migration without finding sufficient game, they were dead. Hunting parties had already gone far up—and downstream, and had returned empty-handed and starving. To press further was to ante up on a weak hand.

If they struck out east or west of the river, they would have to find food *and* water. Balanced against the certainty of hundreds of head of cattle just a kilometer away, it seemed a bad gamble.

"Captain, we're all behind you a hundred percent, whatever you decide to do," the XO said, unnecessarily, Way-

field thought. "These natives were obviously dropped here, or their ancestors were. We don't have any way of knowing whether there are any others on the planet until we're recovered."

"And?" Wayfield asked.

"I say take everything we need now, in one shot. The seed plants, breeding cattle, whatever we decide," Nylund said. "Then we prepare to defend it and see what move they make. We might get lucky; they might complain but not do anything. Or not. If we do it all at once, though, I think we minimize the chances that we'll have to do a lot of shooting."

"And if not?" Wayfield said.

Nylund shrugged. "What else can we do, Captain?"

"What about when we're rescued?" French said, speaking for the first time.

Wayfield knew of all the officers save himself, French felt the most responsible for the predicament they were in. As the engineering officer he'd subjected himself to endless second-guessing about whether he should have caught the reactor leak when they were still close to a port. Anything that they did to the natives would be an additional burden on French's conscience.

"It's you who'll carry the freight, Captain, if we get off this rock," French said. "You'd have to face a board if there's any real shooting."

"That's a risk I'm prepared to take," Wayfield said. "Don't concern yourselves with that. I'll face a board in any case, even if we get away with just losing Mansourian and the others."

"We could lose more people if the natives decide to fight," Nylund said. "They don't seem particularly warlike, but we'll be taking away their food."

It was time to stop the discussion. Up to a point, soliciting your officers' opinions was fine. Doing so gave you more options and made them think creatively, but any further debate on this issue would just increase their trapped sense without bringing any new ideas to the

table.

"Okay," he said. "I want a tactical plan to grab everything we need at once, with a few contingencies: if they fight all-out; if they fight a little; and if they just accept it. Obviously the plan should minimize the opportunity for confrontation. If we can take the goods by stealth, rather than by force, so much the better."

French came back from a reconnaissance of the herd the next day. He was streaming sweat from the three-kilometer walk back from the cattle pastures.

Nylund pushed a crate toward him with her foot. "Take a load off, Frenchie, you look wiped."

The engineering officer settled gratefully on the box and mopped his streaming face with his sleeve. "That's some hike, Captain, and mostly uphill," he said. "We probably need to get the crew trained up a bit more before we try herding a bunch of cattle all that distance."

Wayfield frowned. This was another squeeze. The crew, already on reduced rations, needed more energy to train themselves for physical exertion in planetary gravity.

"Okay, something to consider," he said, noncommittally. "How does the herd look? Will we be able to drive them up here?"

"They're well-used to people," French said. "I've only seen the locals herd them in ones and twos, but they must have to do it in bigger groups when they're moving the cattle to and from the dry-season pasturage."

"Okay. Anything else?" Wayfield asked.

French shook his head. "I'll tell you, Skipper, every time I talk to one of the natives it makes me worry about all the things we don't know."

Though many of the crew had been routinely armed since planetfall, once they started training for the raid, they

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held their weapons with self-conscious seriousness.

Once the officers reviewed the plans, Carde and French had drilled the fifteen riflemen and seventeen cattle drivers, drawing out the tactical arrangement with a stick in the dirt while two petty officers kept watch to ensure no natives wandered by.

Wayfield ruled out a nighttime raid as too dangerous. French, who came from a world with free-roaming cattle, pointed out that it would be harder to get the cattle moving at night, anyway, and harder to control them once they did.

Though his expertise with cattle was solely gleaned from schoolboy trips to cattle stations, French's opinions heavily shaped the plan. They would have to drive approximately twenty-five head north along the bank from the pasture, through the native village and across the fords and up to their camp, a distance of about three or four kilometers.

Wayfield worried aloud that the number of cattle and the distance might be beyond the abilities of thirty-odd inexperienced crewmembers.

"I don't see what else we can do, Captain," French said. "We ought to be thankful that it's the wet season and there's plenty of grass in the pasturage down here by the river. Dry season they'd be spread out over a much bigger area—it'd take a day or more to round them up."

The armed crewmembers, led by Carde, would guard the cattle drivers, led by French. If possible they were to try to take at least one bull, though no one had any idea what the cattle's breeding cycle was like.

Wayfield decided not to try to take any tools or cooking utensils, which could be improvised later, or seeds or greens. It would unnecessarily spread out the small force and give too much time for the natives to react.

The drivers spent several days being lectured by French on how to move cattle and cutting switches such as the na-

tives used. "Always, always, give them a way out," French emphasized. "Especially bulls. Their route of escape should be the way you want them to go."

They'd move the herd across the fords and into a bight of the river downstream that would act as a natural corral, where they could be surrounded and defended by the crew.

Wayfield wouldn't lead the raid himself, of course. Carde would be in tactical command. But, over his officers' strenuous objections, Wayfield wanted to be close enough behind the raiding party to step in if he was needed. Unlike a landing or boarding party, this raid would involve almost all of his crew. His place was with them.

Just before dawn on the day of the raid, Wayfield was filled with foreboding. Even the few crewmembers who were veterans of a gun battle or two weren't trained ground troops. The best of them only knew how to secure a port or clear a ship compartment by compartment. The most junior crew, if they had any inkling at all, knew about combat operations strictly from reading the manuals in their advancement courses.

His real misgivings weren't tactical, though. Wayfield had joined the Guard to be in the rescue service, and had spent his career in the so-called white-hull fleet—the medium and short-range ships—rather than in the more prestigious, and long-legged, research vessels.

Even after almost three decades of chasing emergency beacons, Wayfield got a little thrill every time he read the phrase "proceed at best speed and render assistance," the boilerplate that closed all rescue messages from Search Group.

You took the good with the bad in the service, and Wayfield had seen his share of unpleasant duty, including interdicting illegal ports and enforcing *cordon sanitaire* during epidemics. You made up for those times when you were under heavy boost and just working a nav

terminal took all your strength, on the way to some long-leg ship with a holed hull or an inboard fire. Or a crashed reactor.

He never lost the excitement he felt when they sent the message, "This is Guard Cutter *Malagasy*. We have you on our radar," the signal to stranded crews that their ordeal was almost over.

Taking the cattle by force was a bad business. The only thing that would be worse would be burying more of his crew. Of course crewmembers could get injured, maybe fatally, during the raid, too.

But they had to act now, before desperation set in. So far the crew had responded to the short rations with the usual sailor bitching, but no one had seriously tried to get more than their share of food. Even if that state of affairs persisted until the food ran out altogether—and that was asking too much of human nature—Wayfield wanted to insure that none of his people were tempted on their own to start stealing the natives' food or cattle.

If he gave the orders to take the cattle, it provided a certain amount of moral and professional insulation to the crew, and preserved the command structure, which was more important to their survival in the long term.

Carde and French approached in the dim light to say that the raiding party was ready to move out. A few crewmembers would be left to guard the camp. To avoid alerting the villagers, the rest of the party would work its way south along the river until they reached another ford below the pastures, then cross over. With luck the natives' first inkling that something was afoot would be when the cattle were driven through the village. Wayfield would have liked to take the cattle out along the same route they were using to reach the pastures and avoid the village altogether, but the banks were too high and steep at that stretch of the river for cattle to cross.

"All right, Lieutenant," Wayfield said,

"let's get them moving. XO and I will follow up behind."

"Aye aye, Skipper," French said. He and Carde went back to where the party was massed. A few moments later they heard the soft clatter of rifle actions being worked to chamber rounds.

Once the raiding party moved past, he and Nylund fell in behind. There was enough light to see the column of crewmembers in front of them, but it was still dim under the trees, and there were occasional stumbles and muttered curses.

Wayfield tried to ease the tension in his gut by running over contingency plans in his head, but there were too many unknowns, and the plans themselves fed new anxieties. He hoped Nylund and the others couldn't read his misgivings.

The sun was just above the horizon when they arrived at the southern crossing point. The scramble down one bank, the thigh-deep ford in the icy current, and the hand-over-hand climb up the far bank, was an exhausting, muddy business that left them all short of breath. French had been right about not taking the cattle this way.

There were few trees on this side of the river, and the raiding party was completely exposed in the calf-high grasses. The terrain dipped slightly here, so they were still out of sight of any natives astir this early in the village, but once they crossed the slight ridge that bounded the lower end of the pasture, they'd be visible to anyone that happened to look their way.

Carde halted the party just below the ridge and crept to its rounded top to see if there were any natives in eyeshot. If there were none, the column would continue on in a quiet stalk; if natives were up and about they would have to close the distance from the ridge to the pasture's edge at a run and risk spooking the cattle.

The ridge sloped very gradually down to the pasture below, where about a

third of the cattle were still bedded down; the rest grazed quietly, seemingly unaware of their presence. In the village, nearly a kilometer away, Wayfield could see no one stirred, though a few cooking fires sent thin lines of smoke up from some of the houses. It was a peaceful scene, and Wayfield had a depressing sense that they were about to kick over the anthill.

"Let's go," was all he said.

They filed over the ridge and down toward the pasture with the shooters on the wings and the cattle drivers in the center. Wayfield and his XO hung back until all the raiders had passed, then followed them down into the grazing fields.

When the raiders appeared en masse on the ridgeline, the cattle began to mill around nervously, heads turned to keep the party in sight. Those that had been down on their bellies resting struggled to their feet.

The shooters gave a wide berth to the portion of the herd Carde had designated, acting as a sort of moving funnel with the drivers at its base and the open end pointed at the village.

As they got closer, the herd began to drift away from them toward the north. French ordered his drivers to advance a little faster on the herd's left flank, which bent the stream of animals toward the village.

None of the natives had stirred yet, and Wayfield began to think that the operation might work, after all. Some animals spilled out of the mouth of the funnel as they advanced, hurrying a little to get past the drivers and back to the main body of the herd, but many more than they needed were moving slowly and with minimal alarm toward the path that led through the village and down to the fords.

Now that they were close to the animals and moving across their pasture, the smell of cattle and cattle dung was strong. The moving animals raised some dust, and Wayfield thought it was a

lucky thing that it had rained in the past few days, or they might have been enveloped in a cloud by now.

Problems surfaced when the leading edge of the herd reached the first houses and the animals balked at being hemmed between the structures. The stopped cattle stood in fearful knots, heads turning between the oncoming drivers and the buildings, forcing the rest of the herd to move closer to the drivers along the sides. The cattle closest to the drivers began to speed up, some breaking into an ungainly trot.

As they advanced, the crew fell into a ragged, U-shaped formation that drove the cattle toward its open end. About half of Carde's shooters—the leading edges of the U—had outpaced the bulk of the herd, and were now in the village, advancing on either side of its central dirt path.

When French saw that the cattle were fearful of moving into the relative confinement of the lane, he tried to call back Carde and his men, but the sound of moving cattle drowned out his voice and he only managed to spook the animals closest to him.

The whole mass of men and animals was slowed to a huge, milling plug when the first natives appeared from their houses.

Wayfield cursed as he saw the natives' frantic gestures over the backs of the agitated herd. The natives had yet to see his crewmembers, apparently. They probably didn't realize what was happening, and were just alarmed and confused by the herd's appearance at their collective doorstep.

It didn't matter. Waving their arms and yelling, the natives arrested the herd's last bit of forward motion, and nervous cattle began to double back toward the drivers.

French waved his arms and bawled, trying with his drivers to get the cattle moving in the right direction again, but there were more and more natives pouring into the lane in front of the animals.

Though the cattle were more afraid of the unfamiliar crewmembers, the raiders were outnumbered, and were trying to hold a moving cordon across a much wider space. The herd began to break.

Wayfield and Nylund had gradually closed the distance to French's drivers, and they were now among the sailors trying to keep the herd moving into the village. Though their faces were taut with suppressed fear, the sailors advanced on the cattle, whacking their flanks with driving sticks to keep them moving.

More and more cattle broke back toward the sailors. Seeing that some of his crew was about to be run down, Wayfield drew his weapon.

"XO, fire over their heads," he shouted, discharging his own sidearm into the air.

The effect was electric: the herd went into headlong flight in every direction. Though the fearful cattle tried to shy away from the crew, they were pressed in too narrow a space.

Wayfield saw one driver, a large petty officer in the electronics department, get bumped by a steer's shoulder and go flying backwards into the grass. Wayfield lunged past an animal and dragged the petty officer to his feet, but as he did so he saw another crewmember go down in front of a mass of animals.

Over the incredible noise of running, bellowing animals he could faintly hear firing from the front of the herd, and hoped no other sailors had been trampled.

The operation had become a complete balls-up. Cattle and crew were scattered over a wide area. Carde and French had lost control of their respective detachments, and Wayfield had lost control of them all.

At least one sailor was certainly dead—he'd seen her go under the mass of panicked animals—and there were going to be casualties among the natives.

As the last of the cattle trotted past in ones and twos, French came over, limping. "Captain, we've got to get the crew back to the company area," he said. "I don't know if any head made it to the ford, but . . ."

"You're right, Frenchie," Wayfield said. "The cattle are secondary now. Form the crew up. I saw Street go down—make sure a detail brings her back."

About half the crew remained west of the village. French formed them up and assigned a detail to collect the dead sailor's remains: boots and a gore-soaked coverall that served as a crude body bag for the crushed flesh and bone. Two sailors carried what was left of Street's body on a litter improvised from driving switches and jackets.

Another sailor, unconscious with a head injury, was carried across the shoulders of shipmates.

As they passed through the village they saw that at least a few natives had been trampled, one beyond recognition. The cattle had apparently exploded out of the lane when the firing started, demolishing or damaging a number of the smaller huts.

Most of the villagers appeared to be in shock, and they stood aside as the sad little procession passed. But near the fords they were met by Boget and several other natives, one of whom was carrying a spear.

"What did you do?" Boget demanded. The native was wild-eyed, and had bits of grass in his beard.

"My crew is running out of food," Wayfield said, suddenly feeling very fatigued. "You know this. We tried to bargain, to trade for cattle."

"You tried to *take* them?" Boget said. "Like children?"

"My crew will starve without cattle, Boget," he said. "I had no choice."

One of the other natives pointed with a spear, causing the armed escorts to raise their weapons nervously.

"You are . . . the *bad* people," he said

haltingly, taking no heed of the rifles pointed at him. "Bad! You do a bad thing," he said, and flung his spear to the ground in anger.

The gesture was misinterpreted by a sailor with taut nerves, and a rifle cracked, sending the native down in a spray of blood and tissue from a hyper-sonic round in the chest.

The sailor who fired looked shocked and abashed.

"No, no!" Boget grabbed his hair with both hands. "No!" he screamed at the sailor.

French prevented further tragedy by grabbing the muzzle of another sailor's weapon and pushing it toward the ground.

"Hold your fire!" Wayfield barked. "All of you!"

Another person dead, for no good reason. "Lieutenant, get the party across the river," he said to French.

The natives made no move to stop them; they were bent over the stricken native, talking to him, though he was almost certainly dead before his body had hit the ground.

"Boget," Wayfield said. "I am sorry. That . . . That was an accident."

A native looked up from the fallen man in anguish. "Just go," he said. "Go back where you came from, bad people!"

They'd captured three head of cattle. For that slight accomplishment they'd lost four crewmembers and had three others who were badly injured, including Soyombo, who had a compound leg fracture.

The cattle grazed placidly in the company area, near the fresh graves of Lieutenant Carde and Petty Officers Street, Vang, and Glende.

There would be no rifle salutes today. They couldn't spare the ammunition, and the last thing they needed was to spook the few cattle they had into flight.

The natives hadn't caused a single casualty; all the dead crewmembers were

killed by panicked cattle. Carde, true to form, died with Glende, trying to drag him to safety. Like Street, Vang had been in the middle of the herd when the shooting started, and couldn't get out of its way.

He knew Jan best, of course. Carde had been his ops officer for several years; he would have soon moved up to be XO of a big ship, or command of a smaller vessel. Now he would never see space again.

Glende and Vang he didn't know very well—both had come aboard recently and hadn't made their mark on the crew yet.

Of them all, it was Street's death that affected him the most. He'd seen her go under the cattle's hooves, and she was the youngest of the four—probably his daughter's age, barely an adult.

He wondered anew whether his family knew if *Malagasy* was missing. It was overdue at its port call by now, but the Guard wouldn't have necessarily notified them yet. He hoped, for Luba and Lydia's sakes, that they only found out about the ship after he and the crew were rescued. It seemed like a selfish wish, standing over four new graves.

Carde's death left a void in the wardroom. French, taciturn to begin with, was even more silent and morose after the disastrous raid. The XO, feeling the pressure of their situation and the absence of Carde's easy touch with the crew, was increasingly bad-tempered. She had even snapped once at Wayfield—a lapse that left her obviously mortified and apologetic, but no less brittle.

Three days passed since the raid and neither Boget nor any of the other natives had crossed the river. Wayfield, French, and the XO stood in the company area, discussing their three head of cattle, all steers. They hadn't managed to get one breeding cow or bull, but since they were so few, there was grazing enough in the camp for the animals.

Keeping them close meant that the crew didn't have to mount an extra guard detail downstream where they'd planned to corral the stolen herd.

Nylund wanted to slaughter one of the cattle to supplement their ever-thinning ship's rations—on its face, a good idea. The raid and the death of four sailors had plunged morale through the deck, and fresh meat might help restore them physically and psychologically. Something, though, held Wayfield back.

"We have enough frames to smoke the meat," Nylund was saying. "We should probably get on with it while the weather's dry so it doesn't rot."

"Frenchie, how much meat do you think is on one of those animals?" Wayfield asked.

The engineering officer looked at the cattle thoughtfully. "The big one is maybe 500 kilos," he said. "Less than half that is meat . . . Say 175 to 225 kilograms per head, Skipper, all dressed out."

Wayfield did the math in his head. If each crewmember got half a kilo per day of meat, one animal would last them two weeks, at best. He had caused the deaths of four of his crew and several natives for less than six weeks' worth of food.

Two of his injured would likely recover, but Soyombo was still touch and go, despite the profligate use of their precious antibiotics and plasmites. They'd reduced his fracture as best they could, but he was in for a longish stint at fleet hospitals to repair the bones and restore destroyed muscle tissue. If he lived.

In his career Wayfield had made some decisions that were worse than others—that came with the territory when you made dozens of choices every day—but this was the first time in his professional life that he'd made a *wrong* decision. He hadn't just been mistaken, he'd been too willing to accept a morally repugnant solution. That it had turned out badly was worse for the crew.

"Captain, I'll tell the crew to slaughter

one of the cows?" Nylund said, breaking into his thoughts.

"No, don't do that."

"I thought you said . . ." Nylund began, but he cut her off.

"No, we're not going to slaughter any of the animals," he said, a decision crystallizing in him. "Frenchie, round up a detail of drivers—take as many as you need to make sure the cattle don't get out of control—and return them to the natives' pasture."

"What?!" Nylund threw her arms in the air. "Captain, what are you *talking* about? Are you—"

But Wayfield didn't let her finish. "This isn't a debate, Commander," he said sharply, raising his voice. "I wasn't soliciting your *opinion*. Lieutenant French will form a work party and return the cattle forthwith. Period." He turned to French. "Lieutenant, you'll be the only one armed. Don't fire unless it's to prevent further loss of life, is that clear?"

"Aye aye, Captain," French said crisply.

Some of the crew was within earshot and were obviously following the conversation about the cattle intently, though they'd been doing their best to be unobtrusive. They now gaped openly at the exchange between the officers. None of them had ever heard the captain raise his voice before.

Nylund, clearly stung by the public rebuke, turned on the watching sailors. "What are you looking at?" she said, "There's a ton of wood that needs cutting. Turn to!"

"Belay that," Wayfield said. He only mildly regretted that he had to cut his XO off at the knees in front of the crew—there were bigger issues on the table. "XO, assemble the ship's company in front of the wardroom," he said.

Nylund collected herself with visible effort and called the crew to muster—those few that hadn't already noticed the officers' public disagreement.

"Not you, Frenchie," Wayfield said.

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"Get your people together and go. Now."

The engineering officer nodded and went to collect his detail.

Wayfield stood in the wardroom's doorway—its raised floor was an expedient platform to speak from—and waited for the crew to assemble. He was at ease, now that he'd made his decision. The sailor's expressions were mostly expectant, though some looked troubled. He wasted no time when they were all assembled.

"I've ordered Lieutenant French to return the cattle to the natives," he said. A murmur ran through the crew.

"Despite our food situation, it was wrong to take those steers," he said. "I didn't join the service to be an armed bandit and neither did any of you. Even if we'd brought back the whole herd, even if we didn't lose Street, Vang, Glende, and Lieutenant Carde, we wouldn't be justified in taking cattle at gunpoint."

The crew gave him their rapt attention.

"I can't do anything to bring back our shipmates, or the natives we killed in the raid," he said, "but keeping the cattle would only have made things worse. We're in the rescue service. The law we live by is the law of rescue, and we can't keep that law and the cattle both."

The crew was intent and silent, their faces mostly unreadable. Wayfield didn't care.

"Tomorrow we'll send out reconnaissance parties east and west of the river, preparatory to relocating the camp. We can't stay here and starve, and we *won't* take what we need by force," he said. "Understand what I mean: we *might* survive, if I authorized more raids. But I will not. When the rescue cutter grounds here, it will find a Guard crew, not a band of outlaws terrorizing the natives. Okay, that is all."

Wayfield nodded to Nylund. "XO, dismiss ship's company and join me in the wardroom."

Nylund waited for him to speak.

"I don't need to tell you that I expect your complete support, XO," he said to her.

"Yes, sir," she said, not making eye contact. "I understand."

"Do you?" he said, allowing a little of his own irritation to creep into his voice.

Nylund hesitated for a long moment before she answered. "Captain, I'm not angry because I think you're wrong about the cattle," she said stiffly. "I'm angry because you may be right, and I didn't see it before now."

"You're not the only one," he said ruefully. "Okay, that's all."

The crew was quiet the next day. Scouting parties previously turned away volunteers, despite the hardships involved, but after the raid French could barely manage to fill out two groups of four without drafting sailors.

He and French were going over the maps they'd cobbled together for the scouting missions when a sailor jogged up to the wardroom to tell them that Boget was on his way up from the river.

The two officers looked at each other. When French returned from driving the cattle back to the native pasture, he'd told Wayfield that they encountered no opposition from the locals, but the crew had been watched closely in icy silence.

"Want me to stay, Skipper?" French asked.

"No, it'll be okay," Wayfield said. Since the raid, all the officers wore sidearms all the time, but he didn't think the native was coming to attack him.

Boget gave French a long look as they passed in front of the wardroom, then launched into what he had to say without preamble. "Yesterday I returned five of my brothers and sisters to Mesurda," he said. "Before I am done, your people walk through our village, bringing again the cattle. What does it mean?"

"What we did was wrong," Wayfield began. "Bad for you and bad for us. I am

very sorry it happened."

"Yes?" Boget said. "Bringing the cattle again will not stop the badness. My brothers and sisters are gone."

"And my crew. Four are dead," he said. "But I didn't order the cattle returned for that reason, because of the ones who were killed."

"Then why?" Boget asked.

"Because to keep them would be more wrong, would extend the badness," he said, groping for words. "It was the right thing to return them."

"You expect to see the cattle again will make us happy?" Boget asked, his tone incredulous.

"No, I understand it will only make you less *unhappy*," Wayfield said. "That would be a good reason to return the cows, but that isn't why I ordered it. To keep them would be bad for *us*, for my crew."

Boget was plainly puzzled. "Bad why? You wanted food, then you took the cattle. So you had food."

"Yes, we need food, but our *mission*—not to get home again, but our *big mission*—is to help others," Wayfield said. It sounded ridiculous when put in such simple terms, but he needed to make his point in a way the native could understand. "Sometimes we risk our own lives for the mission."

"Where is this mission from?" Boget asked.

"From the Guard—from *Malagasy*," Wayfield said. To the natives the grounded cutter stood in for a far-flung service they couldn't comprehend. "We will find another way to get food."

"This mission is more important to you than getting the food?" Boget said.

"Yes, in this case, it is."

The native stared at him for a few seconds, his expression unreadable, then shook his head. "Okay," Boget said abruptly. It was the word he frequently used when he failed to understand the peculiar visitors' irritating ways.

French came in as the native stalked off. "How'd it go, Skipper?" he asked.

"Another meeting of the minds," Wayfield said tiredly. "About what you'd expect." He gestured to the maps, "Let's get back to the scouts; I want them to be outbound at first light tomorrow."

The weather closed in during the night, and by morning the crew was crowded in the shelter to avoid the cold torrent.

Wayfield stood in the doorway of the wardroom, disgusted by the weather. The reconnaissance parties would have to be delayed until it broke. The wait would further erode their thin cushion of food supplies.

Nylund and French morosely pored over inventory lists, triaging what needed to be taken and what could be left behind if and when the scouts found a new location. Though Nylund remained a bit cool, to her credit the weather provoked no word or gesture of reproach from her.

The scouting parties were a terrible gamble, but at least they'd be assured of surface water for a few days from the rain. Still, the chance that they'd find a location with sufficient game to support the crew, and at a manageable distance, was razor-thin.

His brown study was interrupted by a chorus of shouts from the river sentries. Now what? he thought, as a messenger slogged uphill in the rain.

Mixon splashed up to the wardroom door like a muddy scarecrow. "Skipper, you got to see this," he said breathlessly. "The locals are bringing up a bunch of cattle; a whole herd."

"Bringing them to *us*?" Nylund said over Wayfield's shoulder.

"Yes, ma'am," Mixon nodded emphatically. "Boget said."

The three officers tramped back toward the river with Mixon. As the petty officer said, Boget and a dozen other natives were leading at least fifty head of cattle across the fords and up toward the camp. Unlike the raiders, Boget's people weren't driving the cattle from

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behind; the animals seemed to be following a bull being led on a short rope.

"What's this?" Wayfield said when he met Boget at the head of the herd.

"You need cattle. Here are cattle for you," the native said with customary brusqueness.

Wayfield looked at his officers. Neither said anything, but even French looked pleasantly surprised.

"Why?" he asked Boget. "Are these to trade?"

"No trade," Boget held up a hand in a preemptory gesture. "That would be

bad for us, for my brothers and sisters." He nodded at the other natives. "When we talked for a long time we saw that this would be a right *mission* for us. To bring you these cows."

"I don't understand," Wayfield said. "You said it was wrong to give us things—like children."

Boget shook his head and smiled in a gentle way Wayfield hadn't seen before. He leaned forward and tapped the captain's chest with one long finger. "This is from you. From Wayfield, from Malagasy." ■

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Robert J. Howe

Robert J. Howe may well be the first science fiction writer of the Space Age. That's because he was born in 1957, only six days after the Russians launched the first Sputnik satellite. His story this month is his third in a year, but he wrote several in the 1980s and '90s, before his recent return to fiction.

Like many writers, his is an exotic career history. He's baked bagels, written publicity materials for colleges, and worked as a technician in an emergency veterinary hospital. There were also stints in the Coast Guard and on an oil tanker and an oceanographic vessel in the Merchant Marine.

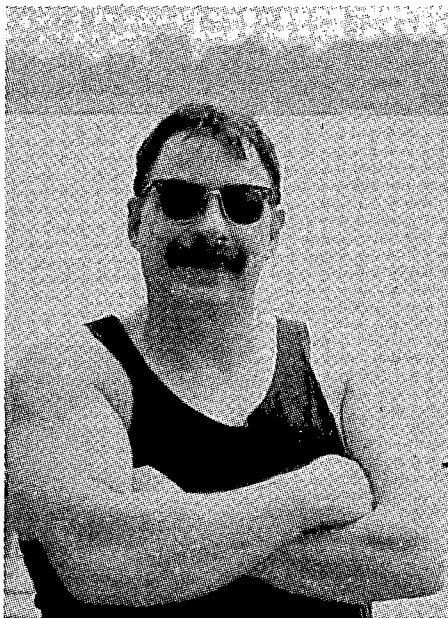
Also like many writers, he thinks the ability to craft fiction is born from life's less pleasant experiences.

"I'm sure that somewhere there's a writer who had a happy childhood," he says. "But my experience is that a bad childhood makes you a tuning fork for other people's emotions. Fiction is a machine for evoking emotion, and you have to feel those emotions to be able to evoke them."

But there's also the matter of learning the craft. For Howe, that began at sea. "That was before emails," he says, "and phone calls were ridiculously expensive. So I wrote hundreds of long letters, trying to be funny and entertaining. When I got out, I knew I wanted to be a writer."

Next came the 1985 Clarion workshop. Being accepted was his first validation as a writer; then the workshop introduced him to the not-always-gentle realm of story critique.

"I told someone the best thing he could do for art was cut off his hands



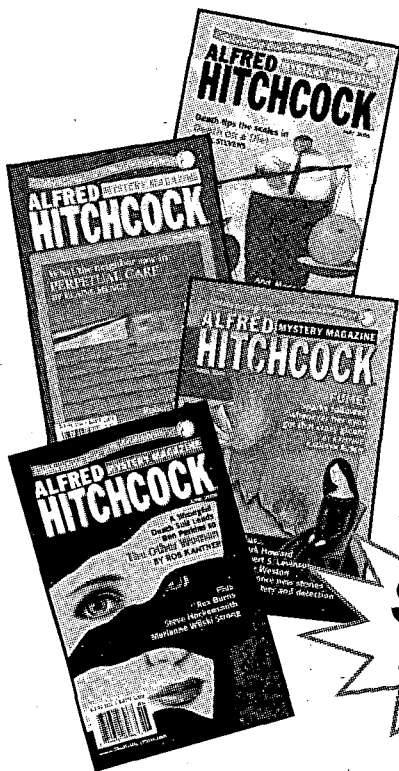
and bury his typewriter," Howe admits. "And my own first story was so dreadful that one of the kindest things people said was that it was like Ken and Barbie in space."

In some groups, such remarks might produce fisticuffs, but Howe's bonded. Now, he helps run a more kindly critique group in Manhattan.

"Fiction writing is the most difficult thing I've ever done," he says, "because it involves keeping so many balls in the air. You rarely manage them all perfectly, but you can't drop any. You have to keep the plot going, you have to have the background, and you have to have a certain facility with character and dialog. There's infinite room for improvement." ■

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THE REFERENCE LIBRARY Tom Easton

Odyssey, Jack McDevitt, Ace, \$24.95, 416 pp. (ISBN: 0-441-01433-X).

Proven Guilty, Jim Butcher, Roc, \$23.95, 406 pp. (ISBN: 0-451-46085-5).

Echelon, Josh Conviser, Del Rey, \$13.95, 291 pp. (ISBN: 0-345-48502-5).

Temping Fate, Esther Friesner, Dutton, \$16.99, 279 pp. (ISBN: 0-525-47730-6).

Bad Prince Charlie, John Moore, Ace, \$6.99, 230 pp. (ISBN: 0-441-01396-1).

Code Noir, Marianne de Pierres, Roc, \$6.99, 309 pp. (ISBN: 0-451-46100-2).

The Space Opera Renaissance, David G. Hartwell and Kathryn Cramer, eds., Tor, \$34.95, 941 pp. (ISBN: 0-765-30617-4).

Jack McDevitt has two series currently running. The last entry in the Alex Benedict series was *Seeker* (reviewed here in November 2005). The last entry in the Priscilla Hutchins series was *Omega* (reviewed here November 2003), and now we have *Odyssey*. Hutch is now the operations director for the Academy that sends out the starships that explore the galaxy. Living worlds are few and far between, and those with intelligent species or their ruins (some of which have been fetched back to Earth) are even scarcer. In *Omega*, we saw a possible reason why: automated engines of destruction that roam the galaxy and target straight lines (think of our own cities!). The bottom line is that there are neither colony worlds to appropriate nor friends to converse or trade with.

Perhaps it is no surprise that the government of the North American Union, which pays the Academy's bills, is having second thoughts. There are plenty of problems at home. Global warming is melting the Antarctic ice cap, and it

could all go at once any day now. Overpopulation is an issue, as is public health. And when one of the Academy's ships vanishes, supposedly many light years from Earth, only to show up on the fringes of the solar system (the engines were having trouble getting traction on hyperspace), the Academy does not look good. Hutch tells her boss that the ships are old, obsolete, in need of expensive overhauls and more expensive replacement. "Fat chance" is the word.

But then sightings of "moonriders" start picking up. Moonriders are black globes that travel in formation. They seem to be spaceships, but they don't respond to attempts to communicate. Government and academic "experts" view them as the latest incarnation of the flying saucer delusion. But Hutch decides to send out a ship to plant sensor systems that might be able to provide hard evidence. Gregory McAllister, the cranky journalist we have met before, goes along. So does Amy, an anti-Academy senator's teenaged daughter. Among

other places, the trip takes them to the Origins project, where the biggest particle accelerator ever built is under construction and researchers hope to gain insight into conditions *before* the Big Bang. McAllister has already heard from physicists who say the experiment might, just maybe, rip a hole in the space-time continuum and destroy the universe. (If you have paid much attention to the science news in the last few years, you've heard the "rip in space" worry voiced in connection with the Brookhaven accelerator [see <http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2003/04/14/MN255128.DTL>], so McDevitt isn't just making this up.)

And it isn't long before they see moonriders. They even witness them pushing an asteroid onto a collision course with one of the few life-bearing worlds out there. And when a tourist resort under construction reports a giant asteroid heading their way, the ship hies off to help rescue the staff.

Are the moonriders responsible? Back on Earth, there are suddenly cries for more spaceships, *armed* spaceships, even an armed space navy. Meanwhile, Amy and McAllister have been parked at a museum while their ship goes on its rescue mission. And in the middle of the night, Amy sees an apparition that looks almost like Hutch and tells her to see to it that Origins is evacuated, for it is about to be destroyed.

McAllister thinks that Amy was dreaming. So do others. But Hutch is just the sort of stand-up lady a writer can build a series around. In previous novels, she displayed talents for bold deeds and no-nonsense decisiveness. Others do the deeds now, but the decisiveness is still there, as strong as ever. When eventually the kid gets to talk to Hutch, she goes out on a limb and pulls together an *ad hoc* evacuation flotilla.

Did Amy actually see anything? If so, was it moonriders? If so, what are they up to? Are they an enemy that warrants

the expense of a space navy? Or are they the galactic equivalent of the Environmental Protection Agency, making sure that we don't destroy the joint? If that's the case, what's with the asteroids?

Well, not everything is what it seems. But you'll have fun finding out what that means.

Recommended. And Jack assures me that there will be a sequel, so you have something more to look forward to.

According to Jim Butcher, Harry Dresden is a wizard who consults with the Chicago cops. His adventures are chronicled in Butcher's eight (so far) Dresden Files novels, which appear to be very popular, partly because urban fantasy is hot, Harry's a very darkly romantic fellow, and he has a way of slicing and dicing his foes despite taking a few nicks himself. On the police force, even those who don't want to admit magic exists have to admit Harry has a pretty high effectiveness score.

Harry's world is shared by the White Council of wizards, Faerie, the Red Court of vampires (bad guys), soldiers of the Lord such as Harry's friend Mike, who carries a mystical sword into battle against evil, and ordinary folks who have nary a clue until something tries to eat them. And there's a war on, or several wars—vampires against wizards, faerie against vampires, Faerie faction against Faerie faction. As **Proven Guilty** opens, his Council superiors are telling him that he should look into a pair of mysteries: why one Faerie faction hasn't declared war on another and what sort of black magic is afoot in Chi-town.

Before long, Mike's daughter Molly is asking him to bail out a friend who has been arrested on suspicion of beating up an old man in a hotel bathroom, said hotel being the venue of Splattercon!! Then the monsters show up, phobophages out of Faerie disguised as horror movie monsters, Molly gets snatched, and Harry, with the aid of friends, must invade Faerie to get her

back, confront his own superiors to save her life, and finally scratch his head over the nature of the mysterious force that seems to be pushing everyone around.

I vastly oversimplify, for I have no mind to describe the subplots, relationships, schemes, and background that decorate the plotline. They're there, they are well done, and they make Harry's world rather more convincing than many other fantasies. Nor does it hurt a bit that Harry is an interesting fellow. Think Buffy in a trenchcoat and have fun.

Many people are deeply concerned today about the extent to which the government wants to keep an eye on everything about us, from our movements on the street to our emails and even our browsing habits. Those who favor surveillance argue that it is for our own good, to protect us against muggers and terrorists, pornographers and sexual predators. They don't seem too worried about invasions of privacy or perhaps we would see less spam and phishing attempts in our inboxes. Worry about privacy is the province of those who argue against surveillance, saying there is little room for it under the U.S. Constitution.

But government snoopingness has a long history, reaching back to the CIA of the 1960s (when long hair was deemed a threat to public order) and the FBI under Hoover. It goes back even further, when in the days after World War II the National Security Agency strove to eavesdrop on international telecommunications traffic. The resulting Echelon program, a multinational effort based in England, processed an astonishing amount of messages.

For our own good, eh? In *Echelon*, Josh Conviser supposes that the Echelon program grew to become a great force for peace and order. It detected and forestalled problems. It promoted peace and aborted war by judicious applications of information and misinformation. It mon-

itored work in research labs around the world and preempted disruptive innovation, either killing or co-opting the inventors. And in due time, Echelon agent Ryan Laing, rock climbing to relieve his mind of guilt and pain, falls to his death. Fortunately, Echelon has in its arsenal of preempted technology a kind of nanotechnology, called "drones," that lets Laing be revived and reassembled. On his next mission, he stumbles across evidence of a high-level conspiracy, and soon Echelon itself has crashed and Laing and his operator, Sarah, are running for their lives.

As soon as Conviser says the computer code that defines Echelon displays unusual logic, the astute reader leaps to the conclusion that aliens must be behind it (after all, mere humans wouldn't want to control the world, would they?). But the characters don't see it. Instead Sarah hares off to the Arctic on what seems no clear clue at all to find an iceberg still bearing an old Cold War listening post, an antique computer, and a memory board still holding the code ancestral to Echelon. This is one of several moments when I wanted to throw the book across the room. The time is many decades after the Cold War ended, a span over which icebergs and ice floes (which were more likely to serve as bases) vanish. And with global warming threatening to make the Arctic ice-free within a few decades, I felt a massive disconnect.

It does not help that Conviser periodically halts the story while Laing and Sarah agonize over their pasts and sprinkles an annoying number of contrived sound-bites throughout his pages. He overwrites egregiously when he could be putting his effort into reading about his world (the global warming thing) and devising ways to smooth out and justify the arbitrary jumps in his plot.

The blurb likens him to Philip K. Dick, who had similar faults. But faults they were and are, and I cannot find it within me to recommend this one.

Esther Friesner has more range than almost any other two writers you can name. She can excel in the dark, serious, adult mode of *Sword of Mary* (reviewed here in the June 1997 issue). And she is superb in the quite light and nonserious young adult mode of *Temping Fate*.

The basic idea is pretty simple. Ilana Newhouse is desperate for a summer job for several reasons. The biggest may be that her sister is being quite insane about her upcoming wedding. Next to that is parental nagging. But the kid dresses like a wannabe goth, complete with an inked skull on her cheek (and didn't sister Dyllin shriek about that!), so she's not having much luck in the conservative Connecticut suburbs. That's when she discovers the Divine Relief Temp Agency, where Mrs. Atatosk thinks skull and attitude are good signs, not bad ones. The kid is hired.

Will it last? The first assignment features a talking spider and a job typing death receipts for the Fates. Yes, *those* Fates. D. R. Temps finds help for the gods themselves, who love to take the occasional day off to go to the beach or their kids' soccer games. Ilana makes new friends amongst the other temps, meets Circe (would you believe she's into feminine empowerment?), and does quite well, right up to the point where half of Olympus shows up at Dyllin's wedding.

The only other author I can think of who could have written this is the late, lamented Thorne Smith. He would have given it a more adult tone (he could be pretty racy), but he would not have made it more fun.

The next stop for this one is the hands of a certain niece.

I enjoy John Moore's fractured fairy tales (*Heroics for Beginners*, reviewed here December 2004, and *The Unband-some Prince*, October 2005), so it was a pleasure to find **Bad Prince Charlie** in

my mail. In brief, it's even better than its predecessors, partly because it is a bit less of a parody and more of a story in its own right. The bad jokes are still there in plenty, but when Moore introduces the down-at-heels kingdom of Damask and its problems—the king is dead, the rain is so unreliable that crop failures are routine, and a neighbor would like to undo the secession of a century before—the story makes perfectly good sense from the start. So does the proposed solution to the problems—recruit Bad Prince Charlie (who earned his sobriquet by abusing a date), illegitimate son of the late king, to serve as regent, get the populace in a rebellious mood, and spark a neighborly takeover. He agrees only when the beauteous Lady Catherine Durace appears to be part of the deal, and then he promptly proves to be not so bad at all. He's been away at school, studying things like engineering, and he has an eye for the books and a tendency to toss corrupt officials into jail. If only that didn't conflict with the Standard Operating Procedures or Culture of Corruption of the bureaucracy, he would actually have a decent shot at setting the kingdom straight. He also has a practical turn of mind, and when he gets the wizardly weather forecast—drought and crop failure—he starts rationing immediately. This ticks off the people. So he's doing all the right things, and rebellion seems right on schedule.

Lady Catherine, of course, turns out to have her own agenda, and the agenda of the uncles who recruited Charlie as Chump Royale turns out to be a bit different from what they said at first. It seems the missing chief wizard just may have created an impressive Weapon of Magical Destruction, and that's what the neighbor *really* wants. Meanwhile there's the High Priestess of Matka, who knows rather a lot about everything, peddles advice, and seems to have a very unholy interest in Charlie.

Some of the story's elements are close kin to things we've seen in the news

over the last few years. That is surely deliberate, for it adds point to the humor. But it also brings the novel so perilously close to political satire that one can actually read it for commentary on how to do certain things right. Perhaps that is why I think it better than the earlier books!

Look for it, and enjoy!

Since Marianne de Pierres is an Australian, it is no surprise to find her novels set Down Under. *Code Noir*, the second Parrish Plessis novel, centers on a refugee camp, the Tert, built upon an industrial zone polluted with assorted nasty chemicals, nanotechnology, and warped people, including kids with mechanical and biological enhancements, including bioweapons. The time is far enough in the future that some of the refugees come from Merika, but not so far that de Pierres thinks referring to architecture as "Art Crappo" doesn't make sense. The past is strong in other ways as well, for the people of the Tert have an assortment of shamans rooted in many cultures, and all their magic works.

Is it science fiction or fantasy? Neither de Pierres nor those quoted on the cover seem to care. She has loads of "futuristic cool" and that's enough. Hollywood, which I suspect warped the author's mind at a young age, often seems to need no more justification than that for its efforts, so it must be true.

Well, no. SF is rooted in rationality. Fantasy is not. And I suspect de Pierres doesn't know or care about the difference. After all, she is capable of hybridizing dogs and rats as "canrats" and of saying that a waterway contaminated with copper sulfate is so toxic that it kills instantly, on contact. (It won't do that even if the active toxin is biological. Even viruses and nerve gases take time!) She also waves the nanotech wand whenever she wants a flashy danger, such as a fiber-optics bundle bursting from the ground to become a tower that

captures and shreds living things.

So what's the story? Parrish emerged from her first novel, *Nylon Angel*, as a hero. Now she wants to get her life back together and find some way to handle the parasite that wants to take her over. But here's the Cabal, saying she has a debt, someone has swiped their shamans, and her job is to get them back, before the King Tide in less than two weeks. They promise help with the parasite if she succeeds. Of course, she doesn't seem very likely to survive, but that's not the sort of thought that stops a Parrish. She puts the word out that she needs info, informers die in nasty ways, and she's off and running, heading for Dis, home to an evil mastermind who plays with the bodies of children as if they were made of modeling clay. Along the way she picks up an assortment of guiding spirits (including a canrat), runs into old friends and enemies, displays her bleeding heart for the reader to empathize with, discovers an overarching, evil scheme, and finally manages to pull at least some of the chestnuts out of the fire.

Alas, de Pierres's characters and world exist at too far a remove from reality. The same can be said about a great many other novels, of course, but other writers generally take some pains to justify their visions. Despite all the futuristic cool and frenetic action, de Pierres does not make me give a darn. One villain remains on the loose, so there is room for a sequel, but I hope she refrains.

"Space opera" used to be a pejorative term. It meant a pretty direct transliteration of the old-fashioned Western into SF, with the hero riding a spaceship instead of a horse and heading the villain off at the nebula instead of the pass. It was written rapidly to formula with the simple goal of collecting a check. It was hackwork.

It was also popular, for it put good against evil in no uncertain terms. The

stakes were high—the fate of humanity, the world, or even the universe. It was exciting, it was adventure, it was unsubtle, and if it makes you think of certain modern SF movies, some critics have in fact criticized those movies as representing no SF past about the 1930s.

Yet today a great deal of SF is cast in a very similar high-stakes, adventurous, exciting, good vs. evil mold, to the point where critics speak of the “new space opera” as a major and even dominant line of modern SF. And when they say “space opera,” they are not knocking it. In fact, they often seem to forget that the term was ever negative.

How did this happen? Hartwell and Cramer track the story in **The Space Opera Renaissance**, with thirty-two examples, a massive anthology. From “World-Wrecker” or “World-Saver,” Hamilton through Leigh Brackett (whose 1949 “Enchantress of Venus” is still readable) and Cordwainer Smith, David Brin, Iain M. Banks, Dan Simmons, Catherine Asaro, Allen M. Steele, Gregory Benford, Ursula K. Le Guin, and Stephen Baxter, to Charles Stross, and many more, the case is clear. Space opera occupies a prominent place in our memories of the best and is indeed front and center on the modern SF stage.

Perhaps we should ask whether the negative use of “space opera” was ever a fair use. It came from the fanzines, which—beloved though they be—were home to some remarkably pretentious and snotty would-be critics. It was given better credentials by some equally pretentious and snotty critics of the British New Wave. From the outside, SF has been condemned as popular in antithesis to more literary fiction. Within the field, popularity has also earned sneers, perhaps because popular writers and works do not advance the field and/or the fight against the external snobs. I have even uttered some of those sneers myself, usually by way of wondering why utter tripe is popular and something better (which may in fact qualify as space opera!) is not.

Call it “space opera” or “adventure SF” or “hard SF” or “modern SF,” a great deal of very good work is done in the category. If you are not interested in the debate over terminology, this anthology is an excellent overview of the category, with enough excellent work by excellent writers to keep any reader happy for a while. It could also serve as a great introduction to SF for young or new readers, and I would love to see copies in every public school and town library. ■

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Dear Dr. Schmidt:

I enjoyed Mr. Rosenkranz's short story, "Preemption" (June '06). The nicely crafted story brought to mind the alternative view written by Eric Russell entitled "Into Your Tent I'll Creep" back in the late 1950's which is also a good read.

C. Henry Depew

Dear Dr. Schmidt:

Just finished reading Carl Fredericks's story ("The Door That Does Not Close"), which I liked very much. However, having visited Romania's Black Sea coast not too long ago, I felt that I should let you (or your proofreader) know that in Romanian, the site in the story is spelled with a small diacritical mark (similar to the Spanish c's cedilla) placed under the second "t" in Constanta, so that is more properly spelled in English (and pronounced phonetically in Romanian) as "Constanța." Unlike the description in the story, Constanța is a thoroughly modern town, but with many interesting Roman ruins (church, baths, the largest Roman mosaic floor ever discovered, a large statue of Ovid, who was exiled there in the 1st century AD) and such modern amenities as a domed casino (not unlike the building the story described), art and archaeological museums, the Black Sea's largest beach, with an amusement park and Water World, and decent restaurants. A very nice place to visit, if you ever have a chance.

Jack Garrett

Hi Stan,

I just read your editorial ("Can't Argue With That," June 2006). I think some of us contributors who hold Christian/Jewish/etc. views actually stated them on that forum only to repeatedly hear that you boycotted such folk. And to get drawn endlessly into Catholic bashing.

It's going to be exciting times on the message board for a while, though!

All of which is a roundabout way of saying you're dead right in your basic point, but it's not just religion: it's everything. Do you think the ultimate culprit is sound-bite politics? I'm not attacking Kansas here—with a gubernatorial election looming in Oregon, we're starting to hear it already. Incredibly mean attack ads from every direction, determined to twist their opponents' views into something inaccurate.

A libertarian friend of mine says that this is a side effect of a drawn-out political process better adapted to 150 years ago, when you had to wait for mail to go overland, and news was slow. Our campaigns are too long, he argues, and therefore inherently dirty. In comparison, he cites the Canadians. Alternatively (also citing the Canadians) he says it's an artifact of the two-party system. Coalition-building governments, such as parliamentary systems, can't afford the bitter polarization, and are therefore more cautious.

His is an interesting point. My thought was that we are so bombarded with the junk our system serves up that it influences how we debate anything

ANALOG

else, even with each other.

Good editorial!

Richard A. Lovett, J.D., Ph.D.

Dear Dr. Schmidt,

Your most recent editorial about the high national profile of "intelligent design" emphasized the importance of genuine national debate on the subject. In connection with the reticence of scientists to participate in a forum that was offered, you made some introductory comments about the need to unequivocally call nonsense nonsense, and the combination led me to write, because I think you unintentionally couched some of your comments in terms that contribute to the problem. I appreciate the strength and acuity of your concern and your persistence in airing it, particularly your pointing out with hugely needed clarity perhaps a year ago that "intelligent design" is not science. I think that is the pivotal issue and needs to be pointed out again and again, yet I never saw it so simply and properly emphasized as you presented it at the time. Probably that is what you refer to in your latest editorial when you say, "Some things are simply nonsense and deserve to be called such, without waffling or apology," but I think it is in several respects unnecessarily, uneconomically (in the sense of Occam and his razor) absolute in a way that I and other appreciators of science like to hear, but also naturally arouses sympathy in the less-science-oriented parts of the public that left to itself does waffle, sympathy for the advocates of teaching "intelligent design" instead of for the advocates of science. A complementary comment of yours in the same editorial, "... if we don't keep the science in science classes, and non-science out . . .," continues what affects me as an excess in a good cause, because insistence on keeping non-science out of science classes seems to me to ask to make a straight-jacket of science for science education.

In public education we have students who have no experience as yet in exercising their citizenship in public life, in any public life, and the crucial function of education is to prepare them to be people in the full sense of the term. I agree that teaching religious tenets has no place in education, but teaching something about religion and its role in public and private life must. Again, history has its classes, and science has its classes, but Galileo's obligation to recant heliocentrism for the sake of the Church is an important part of life, like the current "debate," however well or ill conducted about teaching "intelligent design," and naturally belongs to teaching what is distinctive about doing science. Again, to say science classes should not teach anything but science itself, in practice imposes an artifice that inculcates science in classrooms the way religion is inculcated in parochial schools. I think that rightly bothers people who want the benefits of religion as a center of family life for their children. It isn't hard to teach what you have already formulated, that religion isn't science, and science is the fascinating and endlessly resourceful study of nature, not of God. Its findings give the study of God more fuel, and the study of God can support scientific ingenuity, though it need not and though scientific ingenuity need not depend on it. It seems appropriate to me for such comments and discussion to have some role in science classes to clarify what science truly involves, because it is not obvious. Similarly for calling nonsense nonsense. It is so easy to assert that anything a student says is nonsense that I find it hard to imagine a gain in doing so, except of course to schooling in clarity of expression, which is indeed important. But if a student proposes a flawed idea about nature, where is the educational benefit in labeling that "nonsense?"

I recognize that your subject is the management of a public debate and not

public education in this editorial. Yet where education is the subject of that debate, it can fuel public nonsense with its emotional charge, and even oblique references by scientists can either add fuel or add reason, I hope, depending on the terms in which they are couched. The condition of public debate along with the demise of the commercial news media in our country is horrible, just as you say, but that's a cause, not an effect of a poverty of public recognition of what science is. Rationality and reasonableness is an awful problem in democratic politics now in the USA. But that is a fact of which science is a casualty during depressed economic times with their greedy political haymaking hand in hand with defensive economic consolidation by the "haves" at the expense of the "have lesses."

Joseph E. Quittner
Cleveland Heights, OH

As a teacher, I would take great care never to call what a student says nonsense, even if it is; that could be counterproductive and psychologically damaging. I would, however, try to lead him or her around to figuring that out for himself—and an important part of that process is not hesitating to call nonsense what it is when someone else presents it to the student as fact (and, of course, trying to show why it is nonsense).

Dr. Schmidt,

Part of my pleasure in reading *Analogue* since you became editor-in-chief is the Heidelberg connection—you taught there, my sister Kit attended, my mother and father met there, and my mother's father, H. D. Hopkins, taught speech and theater arts there before he departed to be the president of Defiance College.

Your essay in the June issue rang a whole carillon for me, with its subtle references to debate. Grandpa Hopkins had many tales to tell of trips connect-

ed to Pi Kappa Delta (the forensics fraternity) events. I know that at the time there was no Greek presence in the form of social fraternities and sororities at Heidelberg; rather, there were debating societies. My father, Ed Buhrer, was an EX whose paddle I recall without fondness. He departed Heidelberg in the middle of his senior year to join the Army Air Corps, and was teaching West Point Cadets how to fly B-17s when I was born there in 1943. Think "The Great Santini." But I digress.

In my opinion, one of the vital things about forensics is the enforcement of rules and order by referees. It distinguishes debate from discussion and argument. There's nothing wrong with either discussion or argument, but the imposition of formal rules introduces a rigor and clarity to debate that are frequently lacking from them.

In the earliest Greek Olympics, debate and drama were competitive events with at least as much importance as athletic competition. What are the odds of re-introducing *that* tradition? What might be the consequences?

Eric Buhrer

Salve, Stanlius, *Editor*
Analogue Fabulae Scientiarum:

In *re* thy editorial of the June 2006 issue, as regards those who argue against the evolution of life from the seeds first laid down by God, which I argued some time past, I have written that in matters that are obscure and beyond our vision, even in such as we may find treated in Holy Scripture, we should not rush in headlong and take our stand so firmly on one side that, if further progress in the search of truth justly undermines this position, we too fall with it. That would be to battle not for the teaching of Holy Scripture but for our own, wishing Scripture to conform to our beliefs. Usually, even a non-Christian knows something about the earth, the heavens, and the other elements of

this world, about the motion and orbit of the stars and even their size and relative positions, about the predictable eclipses of the sun and moon, the cycles of the years and the seasons, about the kinds of animals, shrubs, stones, and so forth, and this knowledge he holds to as being certain from reason and experience. Now, it is disgraceful to hear a Christian, presumably giving the meaning of Holy Scripture, talking nonsense on these topics; and we should take all means to prevent such an embarrassing situation. The shame is not so much that an ignorant individual is derided, but that people think our sacred writers held such opinions. Reckless and incompetent expounders of Scripture bring untold trouble and sorrow on their wiser brethren when they are caught in one of their false opinions and are taken to task. For then, to defend their utterly foolish and untrue statements, they try to call upon Holy Scripture for proof and even recite from memory many passages which they think support their position, although "they understand neither what they say nor the things about which they make assertion." So perhaps thou mayest argue with them indeed, in their own terms, as I once did.

I must close now, as the Visigoths are at the gates, making many rude gestures and loud noises.

Aurelius Augustinus, Bishop
Hippo, Africa,
Imperium Romanorum

Dear Dr. Schmidt,

The Kansas City Board of Education aside, one thing has always baffled me about the religion-in-schools debate: Given the attitude and knowledge-level of many teachers and administrators, why would any Christian (or Jew, or Muslim, or Taoist, or Satanist, or . . .) want them discussing religion in school? It seems to me that they would want to teach their religion to their children themselves, so as to present it

with the attention and accuracy they may prefer.

Tim Preston

Dear Stanley,

I've been reading in *Analog* and elsewhere the debate of including creationism in schools or not. I just finished reading your editorial, "Can't Argue With That," and think you are exactly right. It is hard to have a meaningful discussion about a subject when views are so emotional, on either or both sides.

What I don't get is why isn't there room in this world for both views? Why does it have to be winner-take-all? Surely there are a lot of scientists who believe in God and lots of creationists who believe in science. (I'll leave to the reader's analysis as to which set has the highest percentage of a belief in both.)

The problem arises when one side refuses to let the other side have their view taught in the public schools. Our children spend many hours a week, nine months a year, being taught by teachers they love and respect. (Well, usually love and respect.) If the children are taught one side exclusively while being taught that the other view is wrong, that can undermine parents who teach their children the other view. Hence the emotions, since that can create tension in the home, which I hope we all can agree is bad for the children, parents, and society.

Right now, it's the creationists who feel their view is being slighted. If the roles were reversed, wouldn't those who believe that science is right and creationism is wrong feel just as slighted and do the same crazy things the creationists are doing in Kansas?

In fact, isn't that what led up to the Scopes trial of 1925? I'm no expert in that bit of history, but if I remember right, John Scopes was tried for teaching evolution in school. So today the pendulum has swung (maybe we should say, tongue in cheek, evolved) the other way.

I agree, science can be proved and creation can't. I also agree that we shouldn't welcome with open arms every idea that anyone cares to propound and that every opinion is not as valid as other, more provable theories. Since such a large proportion of people in all cultures, current and ancient, believe in a higher power, how can we just ignore it as we might ignore an idea propounded by a single person?

Our children can be trusted to make good choices if they hear both sides of this argument: So let's present both sides of this argument without denigrating the other side as being completely wrong. (This can be done without promoting religion in school.) Creationism probably shouldn't be taught in a science class, but the theory of creationism could be explored in our schools, perhaps as part of a humanities class or in a comparative religion class as long as atheism and "I don't know either way" are taught as some of the comparisons.

All children don't hear both sides at home. Some families ignore science, some families ignore theology (read creationism), and so we can't depend on our schools teaching one and the parents teaching the other. I think it would be a calamity if either subject were left out of our schools and was left to the parents to teach.

If either side postulates that the other side should be marginalized, well, a pox on them. John Scopes should have never been prosecuted for teaching evolution and should never have been told that he couldn't. Presented in the proper forum, neither should someone who teaches the opposite view.

Personally, I don't see a conflict. I think a creationist can teach science and a scientist can teach creation without tearing down the other side. Maybe that's why I am so mystified as to why it's such a polarizing subject.

Well, thanks for letting a old guy like myself have my say. I've subscribed to

Analog for forty years and have seen editors come and go, but, so far, you have done the best job of keeping us informed and on our toes.

Tom Sawyer

Dear Dr. Schmidt:

I am writing with regard to your editorial, "Can't Argue With That," in the June 2006 issue.

I must pay you the highest possible compliment for work very well done:

Using the Kansas Board of Education as an example, you have isolated and characterized one of the more pervasive obstacles to the advancement of rational thought in the new millennium. Those of us who have been trained in science, or logic, or any discipline that involves the fact-based, truth-seeking pursuit of the actual nature of things regardless of what we might wish them to be, are aware that humanity at large is not a fact-based, truth-seeking species. There are forces rooted in our psychology that are stronger than the truth, and we as fallible men and women easily fall prey to them.

I am sure I do not need to point out to you that the very foundation of science is the awareness of our faults and fallibilities as human beings. We see what we want to see, and perceive what we want to perceive. The creation and development of the scientific method stems from the early awareness of the few enlightened individuals who recognized this human failing, and made a deliberate choice to devise a countermeasure—i.e. the scientific method—to protect ourselves against being deceived.

(It would be gratifying to ask those individuals who believe in intelligent design to address this subject from an engineering standpoint as a design flaw. Turnabout is fair play.)

Neither do I need to point out to you that the choice to pursue and accept the truth, even if the truth is difficult, or painful, or requires changing one's

mind or abandoning a belief system, is one of the most difficult choices we as men and women face in our lives. Most people never accomplish it. It is amazing how many otherwise bright, capable individuals never make this step. Any mental health professional with clinical experience will tell you it is the number one reason for the misery in the world. ("What? Accept the truth about myself and deal with it? I would rather live and die in pain, burdened, unfulfilled and unhappy!")

In the end, training humanity at large to live truth-based lives is going to be as difficult as persuading substance abusers to give up their drugs. It is not until humanity at large achieves the not-very-likely epiphany that being unaware is akin to being stoned that the concept has much chance of success.

So what do we as truth-seekers do in the meantime?

We educate people and wait. We lead by example, and welcome those who make the choice to join in. And we use that very same scientific method to identify and expose.

Pursue this with me for a moment. Hypothesis and observation: among humanity at large, faulty, irrational, and even bogus ideas can achieve high levels of acceptance, not warranted by the quality of their content. Those who promote those faulty, irrational, or bogus ideas achieve acceptance and credibility through methods other than logic, reason, and the rational discussion of the merits of those ideas. These methods are amenable to study and analysis—their mechanisms, and their merits and faults, can be identified and disclosed.

As proponents of the scientific method, we acknowledge that by following this process we may uncover truths we don't want to see. Should that happen, we will accept those truths and change our minds.

We will not address the psychology of those individuals who choose to pro-

mote bogus ideas—just their methods.

We expose that the methods are adversarial: first, a choice is made that an idea is so. Then the adversary is identified (that's us) and analyzed. Methods are created, whose goal is to promote acceptance of the idea and undermine the adversary—not unlike what a good attorney does in a courtroom. Not only would a good attorney never let the truth get in the way of the interests of the client, that attorney would also recognize if and when the facts lie with the other side and act accordingly.

This is where your editorial does such good service. We are all aware, at an intuitive level, that a valueless idea can be promoted in such a way as to make rational, fact-based discussion about it impossible. We are, perhaps, not as aware as we could be, that specific methods and techniques are afoot here—techniques that can be learned, and taught to others, who can then go on and promote other valueless ideas in the same manner. Without a clear understanding of those techniques, we are like deer in the headlights.

As a practicing physician in the area of the Nation's Capital, I am often faced with the necessity of debunking valueless ideas, in an effort to protect my patients against making poor decisions about their health care. The Kansas Board of Education is but one example of a pervasive process that can be found all over our society. On a daily basis, I find myself having to warn people about what I have named "Frankenstein logic": the deliberate and selective use of bits and pieces of the scientific method to promote a foregone conclusion. Something made up of strung-together parts of people is not a person, although it may masquerade as one.

Again, my compliments on a fine piece of work.

Dr. Steve Alcuri
Frederick, Maryland ■

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UPCOMING EVENTS Anthony Lewis

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WORLD FANTASY CONVENTION at Renaissance Hotel, Arboretum, Austin, TX. Guests of Honor: Glen Cook & Dave Duncan; TM: Bradley Denton; Editor Guest of Honor: Glenn Lord; Artist Guest of Honor: John Jude Palencar; Robert E. Howard Artist Guest: Gary Gianni. Registration: \$125 until 31 July 2006; supporting \$35. Info: <http://www.fact.org/wfc2006/wfcinfo@fact.org>; FACT, Inc., Box 27277, Austin, TX 78755.

10-12 November 2006

TUCSON 33 (Arizona SF conference) at InnSuites Hotel, Tucson, AZ. TM: Edward Bryant. Registration: \$40 until 5 September 2006, then \$45. Info: <http://home.earthlink.net/~baska>; baska@earthlink.net; TusCon, Box 2528, Tucson AZ 85702-2528; fax: (520) 571-7180.

10-12 November 2006

WINDYCON 2006 (Chicago area SF conference) at Wyndham O'Hare Hotel, Rosemont, IL. Guest of Honor: Jack McDevitt; Artist Guest of Honor: Stephan Martiniere; Editor Guest of Honor: Jacob Weisman; Fan Guests of Honor: Mark and Priscilla Olson; TM: Tom Smith; Special Guests: Barry Malzberg, Mike Resnick, Robert Weinberg. Registration: \$45 until 13 October 2006, then \$55. Info: www.windycon.org; chair06@windycon.org; WindyCon 33, Box 184, Palatine, IL 60078-0184; (847) 310-0725.

17-19 November 2006

ORYCON 28 (Oregon SF conference) at Portland Marriott Waterfront, Portland, OR. Guest of Honor: Cory Doctorow; Artist Guest of Honor: Vincent DiFate; Editor Guest of Honor: Ellen Datlow. Registration: \$45 until 31 October 2006, then \$55. Info: <http://Orycon.org/orycon28>; Orycon 28; Box 5464, Portland OR 97228-5464.

17-19 November 2006

PHILCON 2006 (Philadelphia area SF conference) at Franklin Wyndam Plaza, Philadelphia, PA. Info: www.philcon.org; info2006@philcon.org.

24-26 November 2006

LOSCON 33 (Los Angeles area SF conference) at Los Angeles Airport Marriott, Los Angeles, CA. Theme: Exploring the Golden Ages of Science Fiction. Guest of Honor: William Tenn; Fan Guest of Honor: Fred Patten. Registration: \$35. Info: www.loscon.org; info@loscon.org; Loscon 33, c/o Los Angeles Science Fantasy Society, 11513 Burbank Blvd., North Hollywood, CA 91601. ■

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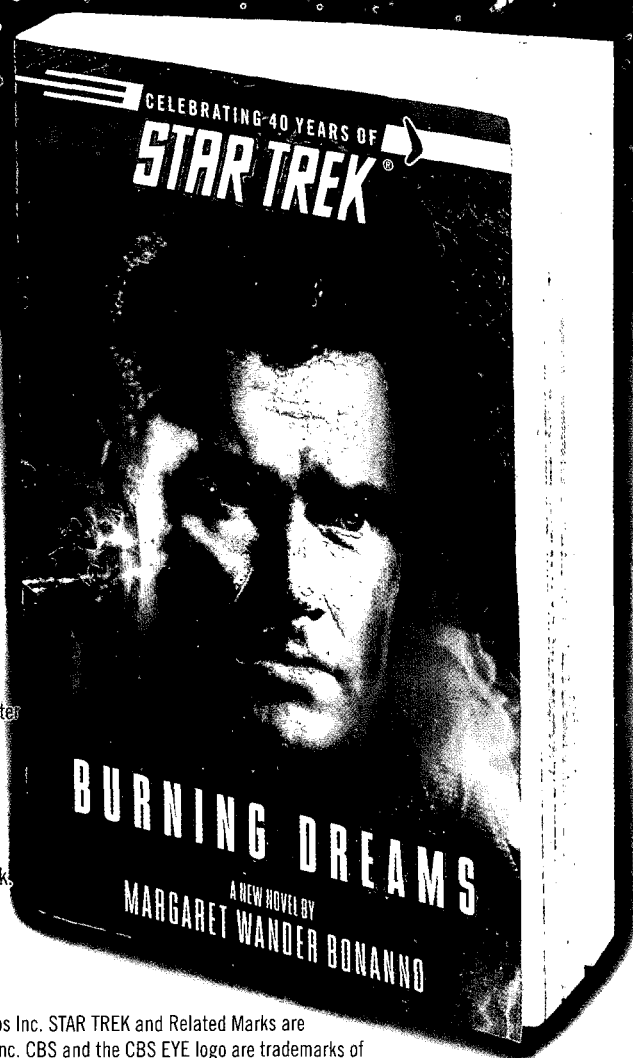
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